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EVALUATION OF A NEW APPROACH TO TARGET ACQUISITION TRAINING: THE COMBAT VEHICLE IDENTIFICATION (CVI) TRAINING PROGRAM

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This report describes the background for, and development of, a prototype Combat Vehicle Identification Program by the Army Research Institute. This research is in response to requests from both TRADOC and FORSCOM.

The ability of U.S. and allied forces to expeditiously and accurately discriminate between friendly and hostile vehicles at extended ranges of engagement is critical if we are to be successful on the fluid battlefield of the future.

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Target recognition training existing prior to the initiation of this research project had one or more of the following weaknesses:

- Did not train for recognition under field conditions, e.g., masking, smoke.
- Had no standardized methodology for presentation.
- Required extensive support in the form of training areas and/or equipment.
- Did not train for recognition at realistic combat ranges (i.e., emphasized vehicle characteristics not visible at longer realistic ranges).
- Did not train for recognition at night using night vision devices.
- Did not provide an ongoing measure of recognition training skills.

The current ARI prototype CVI program described in this report has rectified all of these problems. It provides maximum learning in minimal training time; it requires minimal support; it trains soldiers to recognize only those cues important for recognition at realistic combat ranges; it provides an ongoing measure for recognition training skills; it is modular in design and useable in short training periods; it permits the simulation of all realistic engagement ranges with all optics, e.g., 3,000 meters for TOW gunners with 13 power optics; it provides for the simultaneous training of platoon size groups. The program package is so complete and simplified that most NCO's can present it with essentially no prior preparation.

The prototype basic program utilized 25 different NATO and Warsaw Pact vehicles and is designed to be expanded to utilize a significantly larger amount of vehicles. This basic program was evaluated by selected TRADOC and FORSCOM units, USAREUR, the USAR, and USMC.

The research plan provides for an advanced CVI program which includes recognition and identification of masked vehicles; vehicles partially obscured by vegetation, fog, and smoke; and vehicles viewed through thermal imagery and passive night vision devices.

A unified, comprehensive, and effective combat vehicle identification program is described which is available to all of our armed forces and allies.

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Human Factors in Training
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FOREWORD

The U.S. Army Research Institute for the Behavioral and Social Sciences (ARI), Fort Hood Field Unit, has been involved in developing a broad-based target recognition and identification (R&I) training program. Both TRADOC and FORSCOM have recognized the need for a standardized training program and expressed it through Human Research Needs (HRN) requests to ARI.

This report is one of several designed to evaluate an R&I training program developed by the ARI Fort Hood Field Unit and its contractor, HumRRO. This evaluation examines the technical and training effectiveness of the Combat Vehicle Identification (CVI) Training Program.

Results of this assessment will be used by TRADOC in determining the usefulness of CVI as a standard program for implementation Army-wide.

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EVALUATION OF A NEW APPROACH TO TARGET ACQUISITION TRAINING: THE COMBAT VEHICLE IDENTIFICATION (CVI) TRAINING PROGRAM

BRIEF

Requirement:

A series of Human Research Needs from both TRADOC and FORSCOM have underscored the absence of an effective and standardized training program for recognition and identification (R&I) in the Army. In response, the Fort Hood Field Unit of ARI in conjunction with its contractor, Human Resources Research Organization (HumRRO) developed and tested the first of a planned series of target recognition and identification training programs. This report, the first of a series, describes ARI's testing of this prototype CVI training program.

Procedure:

A series of related research studies of vehicle R&I under the auspices of ARI provided the background for the CVI training program. Key studies addressed the topics of target acquisition processes (Maxey, Ton, Warnick, & Kubala, 1976), problems in helicopter gunnery related to R&I (Haverland & Maxey, 1978), long-range target R&I of camouflaged armored vehicles (Warnick, Chastain, & Ton, 1979), and long-range target identification (Warnick & Kubala, 1979). A complete history of the research leading to the present CVI training program as well as a selected review of the literature on R&I is included at Chapter II.

Discussions with R&I training personnel in a number of units led to the conclusion that training materials used almost always emphasized detailed characteristics of vehicles to be learned. Previous research (references) has indicated that training at closer ranges, where details can be seen, often does not result in satisfactory R&I performance at more distant ranges. The key feature incorporated by the CVI training program is the concept of training soldiers to recognize and identify targets as seen from engagement ranges likely to exist on the modern battlefield. CVI training defines recognition as being able to state whether a vehicle is "friendly" or "threat"; identification is being able to label a vehicle by its commonly accepted name or model number.

The prototype CVI training program consisted of slide and instructional material divided into five training modules, an experimental module, and an overall test module. Five of the six training modules covered the array of 25 vehicles in the program, each module having five views of each vehicle. The sixth (experimental) module repeated five vehicles from the first five modules that are difficult to learn. The final test module was comprised of two views of all 25 vehicles.

The assessment involved sending the CVI training program to 22 active and reserve military units. To date, nine have responded with useable data but all have reviewed the training program and indicated that they were working it into their training schedules. No special instructions or training were

supplied to bias the operational test of the adequacy of the instructional materials. A modest request by FORSCOM to its units to participate in the test was the only official external encouragement given. The inherent value of the training for units bore most of the motivational weight for its use. Data instruments consisted of the tests taken at the end of each module and the 7th overall test module and an instructor evaluation questionnaire. Analysis of variance and Duncan Multiple Range Test were used to compare CVI training with other training in the Army as well as to evaluate the internal consistency of the module and vehicle difficulty. Technical and training evaluations were obtained from 26 instructors who were frequent users of the CVI program in the participating units.

A high level of interest has been expressed in completing the assessment in order to provide TRADOC with information necessary to determine whether or not to adopt the CVI training program as the standard training program for the Army. To accommodate this military requirement, evaluation has been divided into three phases. The first phase will provide a basis for training program planning to TRADOC. The second and third will explore in greater detail more theoretical issues of learning and perception which may ultimately affect advanced R&I training.

Findings:

The subjective evaluation by instructors of the CVI found it "effective" (27%) or "very effective" (69%). Analysis of test results indicate the CVI was significantly more effective as a training program than any being used by tested units (Recognition $\underline{F} = 6.07$, $\underline{p} < .02$; Identification $\underline{F} = 60.33$, $\underline{p} < .001$).

A number of useful comments have resulted in minor modifications in the test CVI Training Program; for example, a new module of updated Soviet vehicles, removal of the M551, substitution of two Soviet vehicles to balance the difficulty level of the modules, and the addition of the XM1 and five additional Soviet vehicles.

Utilization of Findings:

If approved by TRADOC, the CVI Training Program can be used as standardized training in recognition and identification in the Army, Marine Corps, and Air Force.

EVALUATION OF A NEW APPROACH TO TARGET ACQUISITION TRAINING:
THE COMBAT VEHICLE IDENTIFICATION (CVI) TRAINING PROGRAM

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CHAPTER I--INTRODUCTION

BACKGROUND

Since World War II considerable interest has been shown in the problems of target acquisition, i.e., the detection, identification, and location of a target in sufficient detail to permit the effective employment of weapons. New weapons development has resulted in weapons and fire-control systems that can engage targets at ranges far in excess of the ranges at which the unaided human observer can acquire them. Although great technological advances have been and continue to be made, the human eye augmented with optics still provides the best way of recognizing and identifying targets.

Our allies use vehicles that look different from ours and, in some cases, closely resemble those of nations we consider to be a threat to us. Many vehicles have common design characteristics, making distinction of friend from foe difficult.

MILITARY PROBLEM

As indicated above, the demands on human performance in this area of recognition and identification have been increasing in the past several years. The threat armored forces likely to be engaged by U.S. and other NATO units in a mid-to-high intensity conflict in Europe are equipped with antitank missile systems that are both accurate and lethal at ranges extending over 3,000 meters. In addition, threat forces are quite large; it has been estimated that U.S. units in a Central European conflict can expect force ratios as high as six to one (6:1). One of the weapons systems that is intended to operate at extended ranges to counter the threat tactics is the Attack Helicopter (AH) equipped with the TOW weapons system. Using the tactics of flying Nap-of-the-Earth (NOE) and firing at standoff ranges (3,000-4,000 meters) will make AHs far less vulnerable to enemy forward area air defense systems than they would at the ranges required for engaging with 2.75 rockets or conventional tube-type weapons.

In using these tactics it was not known whether helicopter crew members could identify targets at these ranges. At standoff ranges both friendly and threat armored vehicles present very small visual angles, about 3 to 4 minutes, when viewed by the unaided eye. Even with optical aids (such as 7x50 binoculars or the 13X COBRA TOW gunsight) these images are still so small that only gross target features are clearly recognizable. In view of all these factors, concern was expressed by personnel of the 6th U.S. Cavalry Brigade (Air Combat) as to whether armored vehicles could be reliably recognized at extended ranges, even with the 13X gunsight. In response to these concerns, the U.S. Army Research Institute for the Behavioral and Social Sciences, Fort Hood Field Unit, and the Human Resources Research Organization, Fort Hood, (ARI/HumRRO) undertook a series of studies to investigate systematically the problems of recognition and identification at extended ranges. These efforts led to the development of the Combat Vehicle Identification (CVI) training program which is described in this report.

PURPOSE AND SCOPE OF THE TECHNICAL REPORTS

Purpose

The requirement to evaluate the CVI from the perspective of early user availability resulted in the decision to divide the assessment of CVI into three phases.

Scope

- Phase I — This phase concerned itself with a review of previous research related to CVI, with developing technical and administrative details needed for proper handling of the program by the military trainer, and with some performance-related analyses.
- Phase II — In this phase, aspects of the CVI training program associated with the areas of learning and perception will be investigated.
- Phase III — The last phase is a special study which will examine retention and retraining with the CVI program in order to develop performance standards for recognition and identification training.

The present technical report represents the culmination of Phase I.

CHAPTER II--SELECTED LITERATURE REVIEW

RESEARCH LEADING TO CVI

An early study that began this line of research and served to identify problem areas was conducted by Maxey et al.[1] This report was directed toward identifying the factors which influence the target acquisition process and to make a determination of the effects of these factors on the acquisition process in a ground environment.

In preparation for additional research, an analysis of relevant "threat" materials was conducted in an attempt to identify the type of targets and tactics the Army would be most likely to encounter in a European battlefield environment. A review of over 300 documents was conducted and 84 of the most relevant were selected for inclusion in the report. This review of the literature on visual target acquisition was conducted to identify the behavioral, environmental, and situational variables which affect the ability of human observers to perform visual acquisition tasks in field situations. Using this initial information, the ARI/HumRRO research team formulated a systematic series of studies to investigate long-range recognition and identification directed toward answering the following objectives:

> To determine whether helicopter crew members, who had received previous training in armored vehicle identification, could in fact recognize and identify armored vehicles at standoff ranges (3,000-4,000 meters). To determine whether helicopter crew members could be trained to identify armored vehicles at standoff ranges with near-perfect accuracy.

The studies which evolved used a reduced scale model/terrain approach for the following reasons: (1) reduced cost, (2) many of the vehicles needed in the target array are not available in this country, (3) full-scale models are too expensive to fabricate, and (4) experimental control was easier to maintain.

Initially, two experiments were designed and carried out by Haverland and Maxey.[2] The first was a preliminary exploratory experiment, and the second was a larger experiment designed on the basis of lessons learned from the preliminary experiment. The observers used optical aids to view five scale-model armored vehicles; 7x50 binoculars were used in the preliminary experiment and the XM65 gunsight (13X) on the COBRA AH was used in the main experiment. The target vehicles were painted olive drab and viewed against a homogeneous green background.

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[1] J. L. Maxey, W. H. Ton, W. L. Warnick, & A. L. Kubala. Target presentation methodology for tactical field evaluations, Research Problem Review 76-11, U.S. Army Research Institute for the Behavioral and Social Sciences, Alexandria, Va., October 1976.

[2] E. M. Haverland & J. L. Maxey. Problems in helicopter gunnery, Technical Report 78-A36, U.S. Army Research Institute for the Behavioral and Social Sciences, Alexandria, Va., December 1978.

The principal findings from these two studies were:

- Helicopter crew members could recognize and identify the models at scaled ranges of 3,000 and 4,000 meters.

- All of the helicopter crew members who served as observers were able to learn to recognize and identify the armored vehicles to a level of almost 100% correct.

- Target view was the only factor significantly related to recognition and identification performance. Each vehicle was viewed from five different aspects: right side, left side, right oblique, left oblique, and front.

- Differences in recognition and identification performance at the two different ranges (3,000-4,000 meters) were not statistically significant. Likewise, differences in recognition and identification performance for the five target vehicles were not statistically significant.

- Observers viewed five different aspect angles for each target vehicle (side right, side left, oblique right, oblique left, and front) under a wide variety of daylight illumination levels, but no effects of illumination level on performance were found.

It was concluded that target view had a more potent effect on recognition and identification than did vehicle type; the front view being the hardest view and the oblique view the next hardest view to identify. The side views appeared to be the easy views as these views offered the most cues to the observer.

Warnick, Chastain, and Ton[3] conducted two experimental studies using camouflaged vehicles viewed against two different backgrounds: (1) a plain but textured green background, and (2) a terrain background. This second series of studies also used scaled models at scaled target ranges.

In the Haverland and Maxey studies,[4] the effects of camouflage patterns were not identified. It was decided that a logical extension of this work would be a replication employing camouflaged vehicles. It was felt that a comparison of Haverland and Maxey's result with those obtained with patterned vehicles would yield information on the unique contribution of camouflage pattern as it affected recognition and identification performance.

The first study was a replication of Haverland and Maxey's main study. Observers viewed camouflage-painted vehicles (five-vehicle target array) at scaled ranges of 3,000 and 4,000 meters against a homogeneous green textured background. The majority of the results in this study substantiated the findings of Haverland and Maxey.

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[3] W. L. Warnick, G. D. Chastain, & W. H. Ton. Long range target recognition and identification of camouflaged armored vehicles, Technical Report 79-A13, U.S. Army Research Institute for the Behavioral and Social Sciences, Alexandria, Va., May 1979.

[4] Haverland & Maxey, op. cit.

Some of the findings are listed below:

- Camouflage did not affect recognition and identification when presented against a homogeneous background at scaled distances of 3,000 and 4,000 meters.

- Recognition and identification performance scores of nearly 100% were obtained using a five-vehicle target array following 20-25 minutes of training.

- Recognition performance was poorer on frontal than on other views.

- Accuracy of recognition and identification from a particular viewing perspective varied with the type of vehicle.

A second experiment was designed to study more intensive degradation of viewing conditions in order to place the problem of recognition and identification into an environment more closely resembling the "real world" (an HO scale terrain board). The target vehicle array was increased to 10 camouflaged vehicles. Targets were viewed at scaled ranges at 2,500 and 3,500 meters using 13X optics. The maximum viewing range, even with 13X optics, was reduced to 3,500 meters, rather than 4,000 meters, as used in the previous experiments. Preliminary research indicated that the camouflage-painted vehicles started to blend with the multi-colored, highly-textured terrain at ranges beyond 3,500 meters.

Major results are as follows:

- No significant differences emerged in performance at the two ranges (2,500-3,500 meters).

- Identification scores were lower for the 10-vehicle array when compared to the data concerning the 5-vehicle array.

While factors such as camouflage, range, and terrain background were expected to affect recognition and identification, major conclusions reached from conditions used in these experiments indicated that these factors did not significantly affect performance. Following completion of these experiments, staff of the 6th U.S. Cavalry Brigade (Air Combat) requested that a basic training program in recognition and identification be developed. Findings from the preceding studies served as a basis for developing such a program for aircrew members. Results of that effort are described in an ARI Research Report.[5]

CURRENT STATUS OF RESEARCH ON CVI

In addition to the 6th Cavalry Brigade (Air Combat), other organizations (Armor School, Fort Knox, and the U.S. Army Intelligence Center and School) had also identified an overall need to improve recognition and identification as weapon systems changed. FORSCOM's Opposing Force Training Detachment, Red

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[5] W. L. Warnick & A. L. Kubala. Studies in long range target identification, Research Report 1216, U.S. Army Research Institute for the Behavioral and Social Sciences, Alexandria, Va., July 1979.

Thrust, through its Mobile Training Team (MTT), found that in both the active Army and Reserve components there was no standard recognition and identification training program. Red Thrust prepared a briefing on the training program developed for the 6th U.S. Cavalry Brigade (Air Combat) and its Mobile Training Teams briefed it to a number of units who expressed immediate interest.

Because of this general interest throughout the Army in better recognition and identification training, the products of the research for the 6th U.S. Cavalry Brigade (Air Combat) were redesigned and repackaged as the CVI Training Program for testing throughout the Army. Twenty-two CVI training packages were provided to a wide range of military units who were asked to use the experimental package and provide ARI with the training results. The potential of the CVI Training Program to meet an immediate need in the recognition and identification area was recognized by numerous commanders and trainers even before final testing could begin.

The interest thus generated has caused initial emphasis to be placed on the assessment of the CVI user problems. By addressing these needs first in the analysis, modifications can be made in an expeditious manner so that the package can be turned over to TRADOC for their disposition at the earliest possible time.

GENERAL REVIEW OF RECOGNITION AND IDENTIFICATION RESEARCH

Introduction

This section will present some of the more relevant research experiments which were reviewed in the hopes of gaining information which would aid in the development of a basic recognition and identification program. Little research was undertaken in armor vehicle camouflage prior to the 1970's. The renewed interest in camouflage, according to O'Neill and Johnsmeyer,[6] was prompted in part by development in countersurveillance technology. In 1974 the Army adopted a program for camouflage-painting of vehicles and equipment. These patterns were developed by the Army Mobility Equipment Research and Development Center (MERDC) at Fort Belvoir, Va.

The basic MERDC camouflage pattern is a four-color pattern consisting of wavy, irregular patches of color. This pattern is intended to break up the vehicle's outline and make it less conspicuous. In 1976 camouflage painting was temporarily suspended until paints of new formulation could reach the field. These new paints are similar in chromaticity to the old, but have been reformulated to reduce the possibility of detection by infrared sensors.[7]

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[6] T. R. O'Neill & W. L. Johnsmeyer. DUAL-TEX: Evaluation of dual-texture gradient pattern, Technical Report, Office of Military Leadership, U.S. Military Academy, West Point, N.Y., April 1977.

[7] G. Binder & J. Steuard. Modern U.S. Army 4-color camouflage, Armored Forces G-2 Magazine, 5, (8), March-April 1976.

Binder[8] reported that the need for pattern painting and other methods of disguise and concealment have assumed new importance since combat vehicles have become the prime target for a host of ground and air-launched, optically-tracked guided missiles. He also states that the need for new and effective camouflage techniques is further indicated by the likelihood that NATO forces will no longer be able to guarantee air supremacy. O'Neill and Johnsmeyer feel that our critical weapons system (XM1, infantry fighting vehicles, etc.) must be capable of moving frequently, especially under the Active Defense Posture. The Active Defense Posture requires frequent movements which preclude the use of relatively immobile camouflage netting, or even the gathering of natural live foliage. It is assumed by some that utilization of traditional camouflage techniques may prove too time consuming, with the result that tactical movement would be seriously slowed. Therefore, O'Neill and Johnsmeyer feel that the use of traditional camouflage measures should be abandoned in combat as a necessary tradeoff for mobility.

In a somewhat more moderate vein, Farrar et al.[9] conclude that no one camouflage pattern will suffice under all tactical conditions. These researchers point out:

> There is no single level, single assessment, or single measure of effectiveness that is adequate for all purposes or all viewpoints. Instead, there is a series of assessments corresponding to the scope (perspective) or level of the questions being asked about the camouflage and deception problems and all its ramifications.

Cheney et al.[10] support this contention in their reports by saying: "The most a camoufleur can hope to do is to devise a system which will be to his advantage most of the time in most places, or in the most important places." They go on to discuss the many micro-environments, each with its own set of colors, which vary over time. In addition to color, the micro-environments also have a characteristic but time-variant texture. Cheney et al. point out that there is a limited amount of information on texture and conclude that the camoufleur might only be aware of the existence of micro- and macro-textures. Cheney et al. feel that:

> The camoufleur should try, primarily through deployment doctrine, not to become an obvious textured anomaly in the micro-environment with any one vehicle nor present an anomalous textured pattern with a group of vehicles in the macro-environment.

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[8] G. Binder. Modern U.S. Army 4-color camouflage, Armored Forces G-2 Magazine, 5, (6), September-October 1975.

[9] D. L. Farrar, T. S. Schreiber, R. T. Batcher, R. A. Barnum, & H. H. Ott. Measures of effectiveness in camouflage. Part I. Review, analysis, and systemization. Vol I. Measures of effectiveness and the role of models in evaluating camouflage, Report No. CAMTEC-TR-PT-1-Vol-1, Battelle-Columbus Laboratories, Camouflage Technology Center, Columbus, Ohio, April 1974.

[10] T. A. Cheney, G. V. Guiness, & R. J. Eckenrode. Concealment for armor and aircraft, Vol 1, Final Technical Report, Dunlap and Associates, Inc., June 1966.

This concept implies that the camouflage pattern for a single vehicle may need to be different from that for multiple vehicles--depending on their employment. Their idea of a textural spectrum, which must be considered when employing single as opposed to multi-vehicle deployment, is unique and worth further study. Cheney et al. also report some findings from a recent NATO study of terrain in Western Europe. Results reported indicate that: at 3,000 meters it is virtually impossible for a moving tank to detect and identify a stationary tank; detection starts to occur at about 2,000 meters and improves as the distance lessens. A stationary tank, on any but the most open terrain, will not generally be visible at ranges greater than 2,000 meters, even with a clear line-of-sight. The NATO study also noted that firing the tank's main gun at ranges shorter than 1 kilometer will generally disclose the tank's firing position to the enemy; thus, camouflage will be of little value at ranges less than 1 kilometer. At ranges of over 1,000 meters camouflage could be useful in protecting a tank from ground detection.

Foreign Research

Few foreign sources dealing with camouflage research efforts were disclosed by a computer search of the Defense Document Center (DDC) files. Humphreys and Jarvis[11] were cited in a secondary source which contained information on foreign research concerning the effectiveness of pattern painting. They reported some Australian research which used scale models. The Australians found that pattern painting significantly reduced the rate of vehicle recognition at all angles of view and in all lighting conditions. Swedish tests were quoted which showed that detection range for static targets was decreased and acquisition times for moving targets were increased. (Details of the Australian and Swedish test are classified.)

Humphreys and Jarvis further report that the British do not consider pattern painting economically justified by the results. However, after pressure from the British regimental staff, the British Army relented on the basis that pattern painting improves troop morale. Currently, the British pattern is a two-color NATO green and black pattern, similar to the pattern used in Vietnam. Low-gloss paint is used, with infrared reflectances comparable to those of real foliage when photographed with camouflage detection film.

One of the more interesting articles on recognition training was written by Bramley[12] of Great Britain. The article was extracted from a doctoral thesis submitted to London University, and contained an excellent overview of the kinds of research being conducted. He reports that a study was conducted comparing

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[11] A. H. Humphreys & S. V. Jarvis. Camouflage pattern painting report of USAMERDC's Camouflage Support Team to MASSTER, Report 2090, U.S. Army Mobility Equipment Research and Development Center, Fort Belvoir, Va., February 1974.

[12] P. Bramley. Some aspects of recognition training, PhD Thesis, University of London, 1978.

two different theories as advocated by Allan[13] and Wallis.[14] In Allan's view, the trainee should have a "full picture" (frontal and side views of the whole equipment) and compare bits of the equipment to the full views. It is then assumed that the trainee will gradually build up a mental picture of the equipment. Wallis feels that the training should start with pointing out those clues which distinguish one piece of equipment when compared to another piece of equipment. Allan's and Wallis' theories were tried out in a study using two groups of junior NCOs from a Demonstration Battalion and then two groups of Potential Officers. None of the subjects had any experience on equipment recognition training before this study. One group was given pictures of tanks and pictures of parts of tanks; the other group was given the same training materials but was first trained on features which distinguished the test vehicles from the others. It was demonstrated that the group who had received the additional clues did significantly better than those who just received the training materials and were not shown the clues.

In recognition and identification circles invariably the question arises during any discussion of advocating teaching [illegible] "threat" or teaching only "friendly." Little has been offered in the [illegible] empirical guidance until Bramley's article. Bramley reports on a study which used two groups--one trained to recognize only Soviet tanks and the other to recognize only NATO tanks. Both groups took the same final test in which they had only to identify "friend" or "enemy." The group which was taught NATO vehicles made an error rate of 18% on the Soviet tanks, but only [illegible]% on NATO tanks. The group which was trained on Soviet tanks made an error rate of 13% on the NATO vehicles, but showed only a 4% error rate on Soviet tanks. The conclusion which must be drawn from these results, if we are not to have an unacceptably high error rate, is that soldiers must be trained on all equipment that they must recognize.

Bramley reports on a study which tried to ascertain the best method of teaching recognition. Four methods were tested: (1) live instructor, (2) programmed booklets, (3) tape/slide, and (4) Sargeant System. The Sargeant System method utilizes key photographs (in which recognition features are present) and a booklet of cut-up photographs. As it turned out, the programmed booklets proved to be the best method, with the instructor method coming in second. One failing of this study was the small target array and the fact that only Soviet vehicles were used. Bramley does discuss some of the pros and cons in attempting to do this type of evaluation; comparing these four methods was no easy task.

Bramley reports on a study which was conducted by the School of Infantry at Netheravon[15] in which they found that recognizing vehicles on film where either the vehicle or the camera is moving is not the same skill as recognizing

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[13] M. D. Allan. The role of structure in perception and learning, PhD Thesis, University of London, 1950.

[14] D. Wallis. Some implications of recent studies of perceptual training and skill, Occupational Psychology, 1963, 37, 237-254.

[15] Army School of Instructional Technology. Equipment recognition training, 1974.

still photographs and slides. To bridge this gap, they resorted to using a trainer (simulator) in which they trained observers, using models which moved.

Another interesting study conducted by Clare[16] was reported by Bramley. In this study, Clare compared visual performance by tank commanders and instructors who taught recognition. It was found that the average correct detection range for tank commanders was greater than that for the instructors. This result was interpreted by Bramley as meaning that the instructors concentrate on the details which are available in photographs, whereas tank commanders have practice in looking at actual targets at quite long ranges--two different skills were being tested, not one.

Bramley goes on to discuss what key recognition features are actually needed. What Bramley recommends is what we now call the CVI. He states that we should have realistic slides showing side, oblique, and front views at ranges from 3,000 to 5,000 meters, teaching those features that can be seen and are needed for identification. CVI does exactly what he recommends and more.

Van Meeteren et al.[17] conducted a field experiment on object recognition with night vision image intensifiers. The purpose of the field study was to compare the field results with those of indoor experimentation with object recognition using night vision equipment, the purpose being to find out if recognition performance can be predicted from image quality data. The indoor study was reported in a separate report by van Meeteren.[18] The test objects in the field study used full-sized military vehicles such as tanks, trucks, and jeeps. The indoor study used slides of the same military vehicles. It was found that performance proved to be better indoors than in the field, roughly by a factor of 1.5 in terms of threshold contrast. The results of the study concluded that recognition and identification of a set of military vehicles can be predicted from image quality data, in this case, detection of disks upon a uniform background.

Experimental Studies of Camouflage Effectiveness

Studies employing scale models of armored vehicles on simulated terrain tend to yield equivocal evidence concerning the effectiveness of pattern painting as an effective camouflage technique. However, the few field studies found using actual vehicles on real terrain indicate that pattern painting is an effective passive countermeasure to visual detection, recognition, and identification.

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[16] J. N. Clare. Further studies of recognition using the Repertory Grid Technique, Document ST BAC (GW), Bristol, 1975.

[17] A. van Meeteren, J. Boogaard, & J. Haijman. A field experiment on object recognition with image intensifiers.

[18] A. van Meeteren. Prediction of realistic visual tasks from image quality data, SPIE, 1976, 98, 58-64.

Whitehurst[19] conducted two model experiments to determine the effects of pattern contours, the number of colors used in the pattern, and the chromaticity of the colors used on an observer's ability to detect military vehicles with unaided vision. Scale model (1:84) APCs were painted in either the MERDC or Swedish patterns. Both patterns were constructed using either three or four colors. A target painted solid forest green was used as a control. The target vehicles were presented at scaled ranges of 425 and 550 meters.

Under the conditions of the study, the multicolor vehicles were no more difficult to detect than the solid forest green color. Whitehurst's findings did not support the hypothesis that pattern contour and number of colors increase the difficulty of detecting targets. As would be expected, target location was found to significantly affect search time. The data also indicated that acquisition of approximately 80% of the targets could be accomplished within approximately 9 seconds. Pattern color and the size of color patches were held constant in this study. Whitehurst concluded that "differences in pattern-painted vehicles obtained in field tests may be attributable to the fact that pattern color and size were allowed to vary." This conclusion would not apply to field tests with the MERDC patterns as the size and color ratios are held fairly constant among patterns developed for a particular vehicle.

In his second experiment, Whitehurst employed several pattern-painted as well as solid-colored vehicles. The results indicated that pattern type did not affect acquisition performance. This result held even when the vehicles were partially masked from view. However, the colors of the base coat did affect search time. Targets with base coats of dark olive were found to be significantly more difficult to detect than those with green basecoats. Also, there were no significant differences in acquisition times among the solid-colored dark olive targets and the pattern-painted targets. This finding led to a recommendation that darker colors be selected for patterns. Target location was again found to be a significant factor in search time. Whitehurst also noted differences in detection ability among observers due to differences in visual acuity. As distant visual acuity improved from 20/20 to 20/12, the probability of detection in a given period of time increased.

Whitehurst's basic conclusions do not support the need for pattern painting if the simulated conditions of the experiment in fact match those found in the real world environment. However, it was felt that pattern painting may be justifiable for other reasons, such as troop morale.

Grossman[20] conducted two laboratory experiments using terrain models to assess the effects of pattern, range, lighting, and target location on the ability of subjects to visually detect tank targets. In the first experiment the patterns used were the MERDC, Swedish, and German designs. In addition, a single olive drab control target was used. Targets were placed at simulated

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[19] H. O. Whitehurst. The effects of pattern and color on the visual detection of camouflaged vehicles, Report No. NWC-TP-5746, Aircraft Weapons Department, Naval Weapons Center, China Lake, Ca., April 1975.

[20] J. D. Grossman. Effect of camouflage on visual detection, Report No. NWC-TP-5745, Aircraft Systems Department, Naval Weapons Center, China Lake, Ca., April 1975.

ranges of 425 and 550 meters. The MERDC pattern proved more difficult to detect than any of the other three patterns. There were no differences in detection times among the Swedish, German, and the olive drab targets. To obtain a cumulative detection rate of 80% took approximately 9 seconds of search time.

Grossman's second experiment used patterns based on the MERDC, Swedish, German, and British designs. As previously, a single-color olive drab control target was also used. The British and German patterns used two colors, while the others used four colors. It was found that targets were more easily detectable when shadows were not present, and that there was little difference among the camouflage patterns. The overall results indicated that pattern did not significantly affect detection time. Grossman's results indicated that target location and lighting conditions significantly affect the detectability of a vehicle. However, neither lighting nor target location interacted with pattern to produce differences in pattern effectiveness at the ranges tested. The results also indicate that obliterating a portion of the vehicle outline by placing it behind terrain or foliage is a very effective method of camouflage.

Grossman's two experiments strongly suggest that pattern-painting does not effectively reduce the detectability of a vehicle. In fact, Grossman stated: "There is little evidence to suggest that a pattern is more effective than a single color, when the color used is similar to the color that is in the background."

A third scale model study was conducted by Grossman.[21] In this study, scale model tanks and APCs were used as target vehicles. One of the goals of the experiment was to evaluate the effectiveness of disrupters as a camouflage technique. A disrupter is a rapidly deployable mechanism, resembling an umbrella which is used to break up the geometric shapes of military vehicles. Two additional objectives were to: (1) determine whether the MERDC patterns reduced a vehicle's detectability more than the uniform olive drab, and (2) assess the differences in the detectability of an M60 tank and an M113 APC. The tanks had either 12, 6, or no disrupters and the APCs had either 9, 5, or no disrupters. Targets were placed at 1,500 meters from the viewing subjects. Each subject advanced 60 meters at 10-second intervals until the target was found.

Grossman reported that disrupters were ineffective in reducing detection range. No differences in detection ranges were found among vehicles having disrupters and those without them. It was felt that these results were due to the failure to place disrupters on the most conspicuous parts of the vehicles, i.e., track and suspension areas. Comments from the subjects suggest that the vehicle tracks and the shadows of the visible underside contribute most to detection. Disrupters and pattern-painting leave the most conspicuous cues to detection uncamouflaged.

As for the secondary objective, the MERDC tank, olive drab APC, and olive drab tank were about equally easy to detect. The MERDC APC was much more difficult to detect than the other vehicles.

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[21] J. D. Grossman. Effect of disrupters, pattern-paintings, and vehicle type on target acquisition, Report No. NWC-TP-5798, System Development Department, Naval Weapons Center, China Lake, Ca., October 1975.

Grossman's results suggest that future efforts should concentrate on reducing the conspicuousness of structural aspects of tanks and APCs. Additive camouflage techniques (disrupters, skirts, etc.) then might become effective. One of the areas suggested for research concerns the effectiveness of permanent or temporary fender skirts.

Field Studies Dealing with Camouflaged Armored Vehicles

The studies which have had probably the greatest impact on shaping the Army's policies concerning camouflage are those by Humphreys and Jarvis,[22] Jarvis,[23] and Marrero-Camacho and McDermott.[24]

The MASSTER effort (Marrero-Camacho & McDermott) evaluated a large variety of camouflage equipment and techniques (e.g., face paint, drape nets, helicopter hub and blade covers, etc.). The only aspect of the MASSTER report covered in this review deals with camouflage paint patterns and colors for tactical vehicles. The basic MERDC pattern and color combinations were evaluated. The color and percentage ratios for the MERDC patterns are as follows: forest green, 40%; field drab, 40%; sand, 15%; and black, 5%. The MERDC pattern was not compared against other patterns and colors; instead, it was compared with vehicles that were painted with single colors, usually olive drab or NATO green. They found that overpainting the usual white star marking found on U.S. Army vehicles with lusterless black paint was effective in reducing vehicle detection. The highest overall effectiveness rating was given to the MERDC pattern and colors. Its effectiveness in disrupting features was cited as the basis for choice.

In conjunction with the overall MASSTER evaluation, an experiment was conducted using plywood panels painted with various patterns and colors. Subjective ratings from observers were employed and the results indicated that the comparative effectiveness of camouflage patterns and color varied with range, light, background, and foreground conditions. However, the MERDC pattern and color combination was ranked at the top or very near the top of all schemes evaluated under most conditions. A serious flaw in this study was the use of subjective ratings in lieu of experimental manipulations. A second difficulty arises from the absence from the evaluation of alternative pattern-painting techniques. Hence, these findings, despite the great effort expended, can only be regarded as incomplete.

A unique side benefit attributable to pattern-painting was discovered during the MASSTER evaluation. It seems that observations made with image-intensification devices revealed that the solid, single-colored vehicles presented more intense images than the camouflage pattern at 400 meters range and

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[22] Humphreys & Jarvis, op. cit.

[23] S. V. Jarvis. <u>Fort Knox test of camouflage pattern effectiveness</u>, Technical Memorandum, U.S. Army Mobility Equipment Research and Development Center, Fort Belvoir, Va., August 1974. (Memorandum UNCLASSIFIED.)

[24] G. Marrero-Camacho & R. B. McDermott. <u>Camouflage evaluation report (Phase I)</u>, MASSTER Test Report No. FM 153, Headquarters, Modern Army Selected Systems, Test, Evaluation, and Review (MASSTER), Fort Hood, Tex., January 1974.

less. The pattern vehicles presented a more disrupted, less intense image. When aerial infrared imagery was used, all vehicles, regardless of pattern, were discernible as uniformly intense hot spots.

It was also noted that camouflage painting alone is ineffective in concealing military equipment unless it is properly sited to blend with the surrounding terrain. Humphreys and Jarvis support this contention. They feel that pattern-painting materially reduces the threshold of visibility of the item and its recognition characteristics as a military object. It also provides an excellent base for further, more complete camouflage. The MERDC pattern, at the time of the Humphreys and Jarvis and MASSTER tests, was a new experimental approach to pattern-painting within the U.S. Army. It was the first significant innovation since WWII toward establishing a coordinated and comprehensive program for camouflage painting. A good source for more information concerning the MERDC pattern-painting is Technical Bulletin 43-0209.[25]

Cheney et al.[26] report another innovative effort. The purpose of their study was to generate new concepts for concealing armored vehicles. They found that identification became more difficult as the view was changed from a side view to an oblique view, and then finally to a front view.

The identification of the APC was based on its compact geometric shape and its track and suspension outline. Other characteristics did not emerge until the vehicle was viewed at a relatively close range. The data indicated that the tank's signature was perceived as a composite with no distinct components in the sense that specific cues were perceived at various ranges. The cues which appear the most important were the turret/hull outline (small mass on top of a large mass), gun barrel, track and suspension, and turret rear overhang. Of these, the gun barrel was the most frequently utilized cue. However, the geometric outline of the vehicle was a critical cue in all observation trials. The following guidelines for camouflage were recommended:

Close off the underside (tracks and suspension) and/or site the vehicle in defilade positions to aid in concealing the tracks and suspension.

Investigate techniques to make the gun barrel more free form and provide segmented masking of muzzle and barrel sections.

Mask the turret rear overhang.

Cheney et al., in their review of the literature, found that the work done at Fort Rucker on Project OBSERVE was the only study in which data were collected on a large number of targets which varied systematically along more than one dimension. This field study used aircraft and aerial observers to observe ground targets from the air. It was found that targets smaller than 5 square mils were undetectable by most observers. Under optimum observation

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[25] U.S. Department of the Army. Technical Bulletin 43-0209, Color, marking, and camouflage painting of military vehicles, construction equipment and materials handling equipment, October 1976.

[26] Cheney, Guiness, & Eckenrode, op. cit.

conditions, relatively unconcealed targets larger than 50 square mils were usually detected if they were exposed for 5 seconds or more under good viewing conditions. Using 5 mils as an accepted visibility threshold, they computed that if an object were broken up into segments smaller than 8x8 feet it would escape detection at a range of 3,600 feet. Breakup into progressively smaller segments would be required with decreased range. They concluded that at a range of 1,200 feet, patterns should be no larger than 2.5 feet on a side. Some of the same rationale was used in the development of the Dual-Textured Gradient (DTG) pattern.

In a sharply different area of study, O'Neill and Johnsmeyer[27] looked at the role of individual differences as they affect target recognition/identification performance. These authors contend that:

> Despite the continuing development and deployment of modern antiarmor systems, the greatest burden must still be borne by the crewmen to acquire, identify, engage, and destroy enemy targets. A logical and economical first step is to establish selective testing systems which will identify soldiers with the highest potential for mastering these critical tasks. The detection and identification of targets is vital to the functions of ground and aerial scouts, vehicle commanders, and gunners. Identification and selection of soldiers with high aptitude is a continuing goal, and a vital one.

Battlefield targets are seldom clear and unambiguous. Identification of soldiers with high potential for acquisition and identification of camouflaged targets is a reasonable goal for research.

O'Neill and Johnsmeyer hypothesized the existence of three perceptual skills which may defeat the effects of camouflage: (1) perceptual organization properties (Gestalt properties), (2) cue-search skill, and (3) perceptual set. One of the objectives of the study by O'Neill and Johnsmeyer was to isolate and study the effects of the first two of the three hypotheses--Gestalt properties and cue-search. Two paper-and-pencil instruments--the Degraded Letters Test and the Cue-Search Test--were evaluated in a laboratory situation as possible predictors of individual ability to detect and identify camouflaged targets. Both tests appeared to offer promise, but verification of their efficacy would require validation under field conditions.

Dual-Texture Pattern Gradient Evaluation

The ideal camouflage pattern should offer maximum concealment value under all common threats and terrain conditions without requiring the use of extensive garnishment. The pattern developed by the Psychology Committee at the U.S. Military Academy seems to offer some promise in meeting these criteria. The Psychology Committee's pattern is derived from that developed by the U.S. Army Mobility Equipment Research and Development Command (MERADCOM). Two laboratory and field experiments were conducted to evaluate this new pattern, termed

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[27] T. R. O'Neill & W. L. Johnsmeyer. Investigation of psychometric correlates of camouflaged target detection and identification, Technical Report, Office of Military Leadership, U.S. Military Academy, West Point, N.Y., May 1977.

the "Dual-Textured Gradient Pattern" (DTG). The laboratory study was conducted by O'Neill and Johnsmeyer.[28] The field study was carried out by O'Neill.[29]

Both studies agreed that the DTG pattern was not readily distinguishable from the standard pattern at longer ranges without optical enhancement. At longer ranges the DTG pattern merges into a macro-pattern of broad light and dark areas which matches the texture of the background. At closer ranges, under optical magnification, a micro-pattern evolves which again matches the background. The authors emphasize that the DTG pattern was not designed for use with garnishment.

The laboratory study simulated summer and winter environments by using 35mm color slides of various panels painted with various patterns taken during the appropriate season. Targets were photographed at distances ranging from 78 feet to 675 feet. The slides were taken at 25-foot intervals. Subjects viewed the projected slides on a large screen. The target object was a 4x8 foot wooden panel painted either a pattern or a solid color. The following two groups of patterns were evaluated: (1) summer condition; U.S. Army standard pattern, DTG, dark green panel (control target), and (2) winter condition; U.S. Army standard pattern, DTG, Swedish, and solid white panel (control target). Subjects were 260 students from the U.S. Military Academy at West Point. Results for the summer condition indicated that the means for the standard and control panels did not differ significantly. Overall, the DTG pattern mean differed from those for the other two patterns beyond the .01 level of significance, indicating the DTG was hardest to detect. Under the winter condition the DTG was harder to detect than the standard and Swedish patterns. Little difference was found between the white control and DTG panels.

O'Neill and Johnsmeyer report some support for the hypothesis that detection of camouflage is a combination of visual search habits and fairly specific and stable perceptual organizing properties. During this laboratory study, some subjects were unable to recognize the DTG panel even when the target outline was traced on the screen by the experimenter, yet, the patterned panels were clearly visible to other subjects. This appears to

> . . . illustrate (what) is probably the most important single factor in camouflage detection: knowing the nature and location of the target will defeat any measure known. If you know what the target looks like and where it is, its signature will usually be overwhelming; but (this) does not mean it will be easily detected by a naive observer.

As noted previously, the O'Neill study was conducted in a field environment. Subjects were 10 warrant officer attack pilots and 28 EM artillery observers of the 82d Airborne. All subjects had received some vehicle recognition training. The target vehicles were M113 APCs painted either in the standard

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[28] T. R. O'Neill & W. L. Johnsmeyer. DUAL-TEX: Evaluation of dual-texture gradient pattern, Technical Report, Office of Military Leadership, U.S. Military Academy, West Point, N.Y., April 1977.

[29] T. R. O'Neill. DUAL-TEX 2: Field evaluation of dual-texture gradient pattern, Technical Report, Office of Military Leadership, U.S. Military Academy, West Point, N.Y., July 1977.

four-color Army pattern (forest green, light green, field drab, and black) or in the DTG pattern which used the same four colors. Natural garnishment was applied to the front of each vehicle, the commander's station, and the ventilator dome. Subjects observed the targets through a TRW-3 Russian commander's sight affixed on a T-62 tank. This sight has relatively low magnification. Target vehicles were presented against the edge of a treeline at a distance of 926 meters. Subjects were told to search for any military target (type was not specified) located between the 8 and 30 range lines on the sight. Subjects were given 60 seconds to observe the target area. Mean time to detect the standard U.S. Army pattern was 22.32 seconds, while 40.35 seconds was required for the DTG. This difference in mean detection times was significant. However, the DTG pattern was more difficult and time consuming to apply than the normal U.S. Army pattern, although the difference in difficulty did not appear to be unreasonable.

General Recommendations for Camouflage

Listed below are some general principles, rules, or recommendations which were derived from two sources concerning camouflage.

The report by Cheney[30] states that the essential properties of good camouflage are:

> The capacity of the material to reflect infrared radiation must be as similar as possible to that of the surrounding terrain.
>
> Colors must be as pure and as saturated as possible.
>
> Matte finishes are best to avoid reflections.
>
> The pattern used to camouflage should be as broken and undefined as possible. With a broken pattern in a vegetated landscape, such as a jungle, the natural shadows and lighting will help produce the desired effect.

Wise[31] published an historical recounting of American military camouflage and markings from 1939 to 1945. Much of the information appears to be based on research that was conducted during the war years and substantiates much of what has been rediscovered today. These findings are as relevant today as they were then and are included here so they may not be lost.

- Regularity of shape will identify an object and shadow will reveal the shape of an object far better than its own outline.

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[30] T. A. Cheney. Concealment for armor and aircraft, Vol 2, Final Technical Report, Dunlap and Associates, Inc., June 1966.

[31] T. Wise. American military camouflage and markings 1939-1945, Surrey, England: Almark Publishing Company, Ltd., 1973.

- For concealment from ground forces a background should be chosen which will visually absorb the subject without changing the appearance of that background more than is necessary.

- Evergreens make the best natural camouflage as they last longer without wilting.

- Foliage should be positioned so that the top of the leaves are right side up. The upper surface of most leaves are waxy and considerably darker than the underneath sides.

- Paint is most effective when used on fixed installations. Its main limitation is that it has no texture of its own and texture is one of the major factors of successful camouflage. (Underlining added by present authors.)

- The use of paint for camouflaging vehicles may be split into four basic principles: color matching, countershading, coinciding patterns, and disruptive patterns.

- The color used must be several shades darker than the surrounding terrain in order to be matched. This is because a textured surface on the ground looks darker from the air.

- The selection of semi-gloss or lusterless olive drab was chosen as the most average color for blending with all the various terrains our forces operated on in WWII.

- When selecting a second or third color for use in a pattern, the greater the contrast in colors to the surroundings the more visible the object will become. Contrasting colors, especially light ones, when used in a foliated terrain tend to attract the eye, and in this type of terrain much is to be said for retaining the basic single color, which should be toned down to the darkest color in the surrounding terrain.

- In countershading, to reduce the natural reflection and shadow outline, paint should be applied to blur the outline; for example, dark paint to surfaces reflecting the most light, light paint to surfaces in the shadow. This method of shading can play a particularly important part in the camouflage of gun barrels. (Underlining added by present authors.)

- Methods of dealing with gloss: Cover areas with a film of oil and earth, or sand. Paint edge of gloss areas in black paint.

- Camouflaged patterns used should be related to nearby shadows and ground shapes, making the pattern shapes general, not definitive. Regular outlines, regular spacing, and symmetrical shapes should be avoided.

- Patterns should be bold and contrast between light and dark paints very pronounced. This is because when observed from a distance and especially from the air, color perception is diminished so that feeble contrasts in color, or small patterns, will fade, leaving the object plainly visible.

- The most difficult shape to simulate is a shadow. Black paint may appear very light under certain light conditions. When viewed from the air, shadows are the blackest part.

- In case of aerial observation, color perception diminishes at high altitudes and patterns therefore tend to merge into shades of gray.

- If patterns are too small, they will merge into overall color and will not conceal shape. Also, small differences of color cannot be distinguished from the air, causing small patterns to be ineffective.

- Size of pattern will depend on size of the object being camouflaged.

Wise pointed out that the first known appearance of U.S. Army vehicles with camouflage paint during the WWII period was in the summer of 1941 during summer maneuvers. He also stated that disruptive patterning became more common during the Italian Campaign, especially as the warfare became more static. Camouflage in Germany was achieved mainly by using pine branches.

Evaluation of Training Methodologies

Cockrell[32] evaluated four different methods of training image interpreters in target identification. Recently trained image interpreters were used as subjects. Two of the four training methods used pictures instead of text, one method presented the pictures in a random sequence, and the other method presented the pictures in a structured sequence of increasing difficulty. The third method used a programmed text to teach verbal identification cues, and the fourth method combined programmed text in the first half and the structured pictorial method in the last half of training. In each method, half the students received feedback of both the correct answer and the reason for being wrong; half of the students received only the correct answer.

Cockrell's results indicated that identification performance was the same across all three methods using pictures. Performance was significantly poorer with the programmed text method. Recognition of target cues was significantly better when verbal instruction on target cues was given than when training was entirely pictorial. Surprisingly, the type of feedback had no significant effect. Interpreters with lower aptitudes forgot their training more rapidly, but learning performance did not differ as a function of their General Technical (GT) aptitude scores.

Kottas and Bessemer,[33] in their experiment, examined observer performance in learning to identify slides of tank targets at scaled ranges of 2,000 and 4,000 meters while using 8X optics. Subjects were scored on their recognition and identification performance both before and after training was given on two

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[32] J. T. Cockrell. Evaluation of four target-identification training techniques, Technical Paper 301, U.S. Army Research Institute for the Behavioral and Social Scienes (ARI), Alexandria, Va., August 1978.

[33] B. L. Kottas & D. W. Bessemer. Behavioral bases for determining vehicle detailing in simulation displays, U.S. Army Research Institute for the Behavioral and Social Sciences (ARI), (In Press) 1980.

experimental R&I programs. The experimental program, in part, made use of slides and narrative from the Combat Vehicle Identification (CVI) Training Program developed by ARI/HumRRO. Kottas and Bessemer essentially replicated studies conducted by Haverland and Maxey[34] and Warnick, Chastain, and Ton,[35] but under different conditions. The results of this study agree in almost every regard with those of the earlier studies. The one essential difference in the study by Kottas and Bessemer is that they used slides to depict the target vehicles. Previous ARI/HumRRO studies used actual HO (1:87) scale models painted in olive drab or camouflage pattern viewed against a homogeneous green or terrain background. The results obtained by Kottas and Bessemer substantiate the fact that slides can be substituted for the actual models in the training process without causing a degradation of observer recognition and identification performance.

Some of the results found by Kottas and Bessemer were:

- The difference between performance at simulated scaled ranges of 2,000 and 4,000 meters was not statistically reliable either before or after S's received the experimental training.

- Differences in performance among observers trained at 2,000 and 4,000 meters were not significant.

- The experimental vehicle identification training program raises target identification performance significantly over that provided by Armor One Station Unit Training (OSUT) regardless of some variation in training and testing range. This study also showed that there is room for improvement in identification performance.

- Performance differed for different vehicle views (side right and left, oblique right and left, and front). It was found that subjects learned the most about identifying flank views of vehicles and least about identifying frontal views. This confirmed results of previous ARI studies.

Summary and Discussion

The literature clearly illustrates that different results have been obtained depending on whether a study was conducted in the laboratory or in the field. Laboratory results showed that olive drab or dark green vehicles are as hard to detect as pattern-painted vehicles. On the other hand the field evaluations have found the pattern-painted vehicles to be very effective when compared to a uniform olive drab color. The reason(s) for these contradictory findings is (are) largely unknown.

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[34] E. M. Haverland & J. L. Maxey. Problems in helicopter gunnery, Technical Report, 78-A36, U.S. Army Research Institute for the Behavioral and Social Sciences (ARI), December 1978.

[35] W. L. Warnick, G. D. Chastain, & W. H. Ton. Long range target recognition and identification of camouflaged armored vehicles, Technical Report 79-A13, U.S. Army Research Institute for the Behavioral and Social Sciences (ARI), Alexandria, Va., May 1979.

The literature seems to support the contention that there is no single universal camouflage pattern that will suffice under all conditions. Evaluation of the DTG pattern seems to indicate, within some constraints, that it closely approximates a universal pattern.

The only systematic U.S. research effort conducted appears to be the studies of MERDC at Fort Belvoir. Some foreign countries evidently have conducted extensive research into the area of camouflage patterns; however, little empirical evidence of effectiveness was uncovered. There is a clear need to conduct further research into the development and evaluation of different patterns for use in various operational areas. Research into the development of special patterns for use in various geographical areas would appear to be valuable to afford better protection for critical weapons systems.

Military personnel feel that pattern-painting does have a positive effect on the morale of troops and does make them more camouflage-conscious. The pattern-painted vehicle also requires less effort to conceal it further with garnishment.

The use of psychological tests should be investigated for identifying individuals who have a high potential in detecting and identifying camouflaged targets. Preliminary studies using the Degraded Letters Test and Cue-Search Test have shown some promise.

As a research area, the detection, recognition, and identification of vehicles employing camouflage patterns appears to be virtually untouched. Based on the results from Cockrell's study, the CVI combines two elements that were found to distinguish better methods of teaching recognition and identification: the use of pictorial training in combination with live instructors to teach target cues.

Kottas and Bessemer found that the CVI Training Program did indeed raise identification performance significantly over the training received in OSUT, regardless of some variation in training and testing range. They also found that there is still room for improvement in recognition and identification performance following training under the conditions involved in the experiments.

CHAPTER III-- THE COMBAT VEHICLE IDENTIFICATION (CVI) TRAINING PROGRAM

OBJECTIVES

The major objective of the CVI Training Program is to train soldiers in what cues to look for to identify vehicles at realistic combat (engagement and pre-engagement) ranges. Further, the design of the materials and procedures tries to incorporate the following subobjectives:

- Provide a controlled, standardized training package.
- Provide a basis (measure) for evaluating the level of success reached by trainees in identifying vehicles.
- Allow scheduling flexibility through its design in 5-vehicle modules.
- Employ a minimum of support materials to keep training simple.
- Permit training of varying users' optics/distance requirements in a classroom through simulation procedures.

COMPOSITION OF THE CVI TRAINING PROGRAM

The basic CVI training program consists of slides and printed materials divided into five training modules and an overall test module. In addition to the basic program, an experimental module (number 6) of intermediate level difficulty was included. This experimental module was developed so that data collected might serve as a basis for deciding whether an intermediate level CVI training program (such as modules for specialized MOSs) would be necessary to bridge the gap between the basic CVI and an advanced program (which uses masking) now under development. The basic training modules cover the array of 25 vehicles which comprise the basic training program. Each of the first 5 modules uses 5 of the 25 vehicles photographed in 5 different positions (front, oblique right, oblique left, side right, and side left). Further, each module is divided into: (1) a <u>manual presentation</u> phase during which slides (vehicles) are projected one at a time onto a screen;[1] (2) an <u>automated presentation</u> phase during which the slides are shown every 15 seconds; and (3) a <u>test</u> phase in which three views for each of the five vehicles covered in the module are presented at 8-second intervals for trainee-written responses. During the <u>manual presentation</u> phase, the trainee makes a written recognition and identification[2] response, the instructor then describes key cues relevant to recognition and identification of the vehicle, and the trainee has a chance to ask questions.

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[1] Slides projected present vehicle image sizes representative of what the soldier would actually see at realistic combat ranges.

[2] Recognition is being able to state whether a vehicle is "friendly" or "threat," and identification is being able to label a vehicle by its common or accepted name or its correct model number.

During the automated presentation phase, the trainee again gives a written R&I response, the instructor reiterates the key cues for R&I response but permits no questions.

The sixth (experimental) module is composed of five vehicles which appeared (generally) in different basic training modules; previous research has indicated that the selected vehicles are very difficult for trainees to learn.

The final test module is composed of two views (frontal and an oblique) of all 25 vehicles and uses an 8-second exposure for presentation and for trainee-written responses.

In scoring the test, the trainer starts with a score of 100. One point is deducted for each "don't know" response, and two for each wrong answer. Thus, a greater penalty is assessed for a mistake than admitting lack of knowledge. The rationale for this scoring is that it is far worse in combat to mistakenly kill a friendly vehicle, or to allow an enemy vehicle to gain an unnecessary advantage because the gunner in error believes it to be friendly, than to honestly not know whether the sighted vehicle is friend or foe. In the latter case the gunner will presumably get help as soon as possible or take cover while waiting for the vehicle to move to a position where he can identify it positively.

The instructional materials consist of: (1) an overall guide for the use of CVI giving detailed instructions for all phases of the training; and (2) a complete script for the instructor for the experimental and each of the five training modules, plus general reminders for presentation. This reduces instructor preparation time to nearly zero.

What the soldier sees in the CVI program that is different from a usual slide presentation is the heart of the CVI program. He sees an image of a vehicle on the screen that resembles in both size and identifiable characteristics what he would actually see if he were in the field looking at it. Furthermore, simulation of any power and/or optics is a regular part of the training. Hence, for example, a TOW gunner using 13 power optics at a range of 3,000 meters or an infantryman without optics at 500 meters can both be trained, simultaneously if desired.

The seating arrangement in the classroom is important in order to minimize image distortion. Of necessity class sizes are usually held to not more than 35 for best results. Figure 1 shows how a class should be seated.

To achieve the correct simulated distance and optics combination, tables are provided in the instructor's manual as part of the CVI training program. See Table 1 at Appendix A in this report for an example of the distances used in a large classroom.

Figure 2 displays how the vehicle photography was done. Appendix A gives a technical description of the procedures used to produce the master slide set.

Throughout the CVI program, the trainee is a participant. He must attempt both to recognize and to identify the vehicle by responding on work sheets provided. Hence recognition and identification are combined into one training program such that a soldier's progress on both can be measured and tracked.

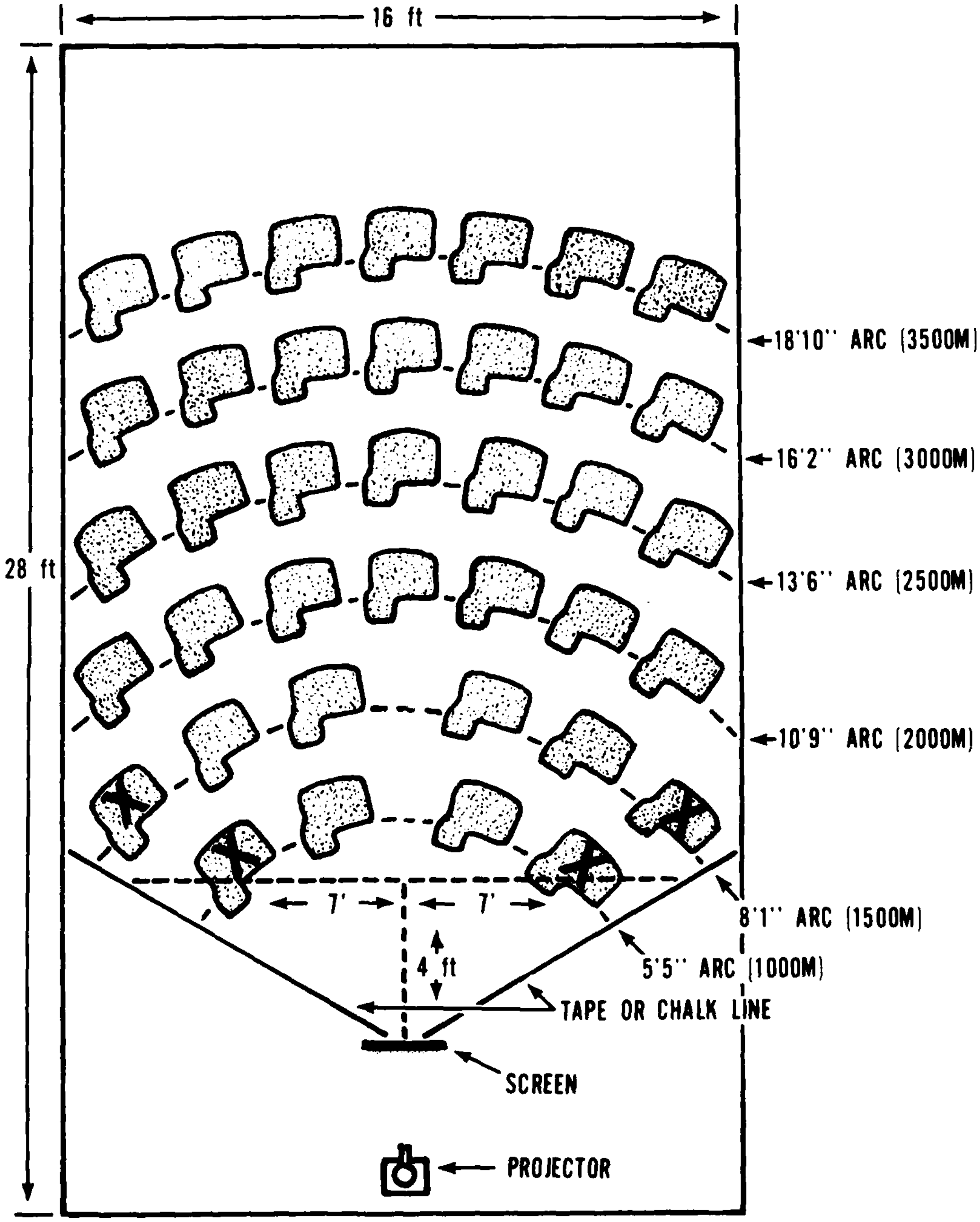

Figure 1. Classroom arrangement for simulating a 7X optic at ranges of 1000M, 1500M, 2000M, 2500M, 3000M, and 3500M in a small classroom.

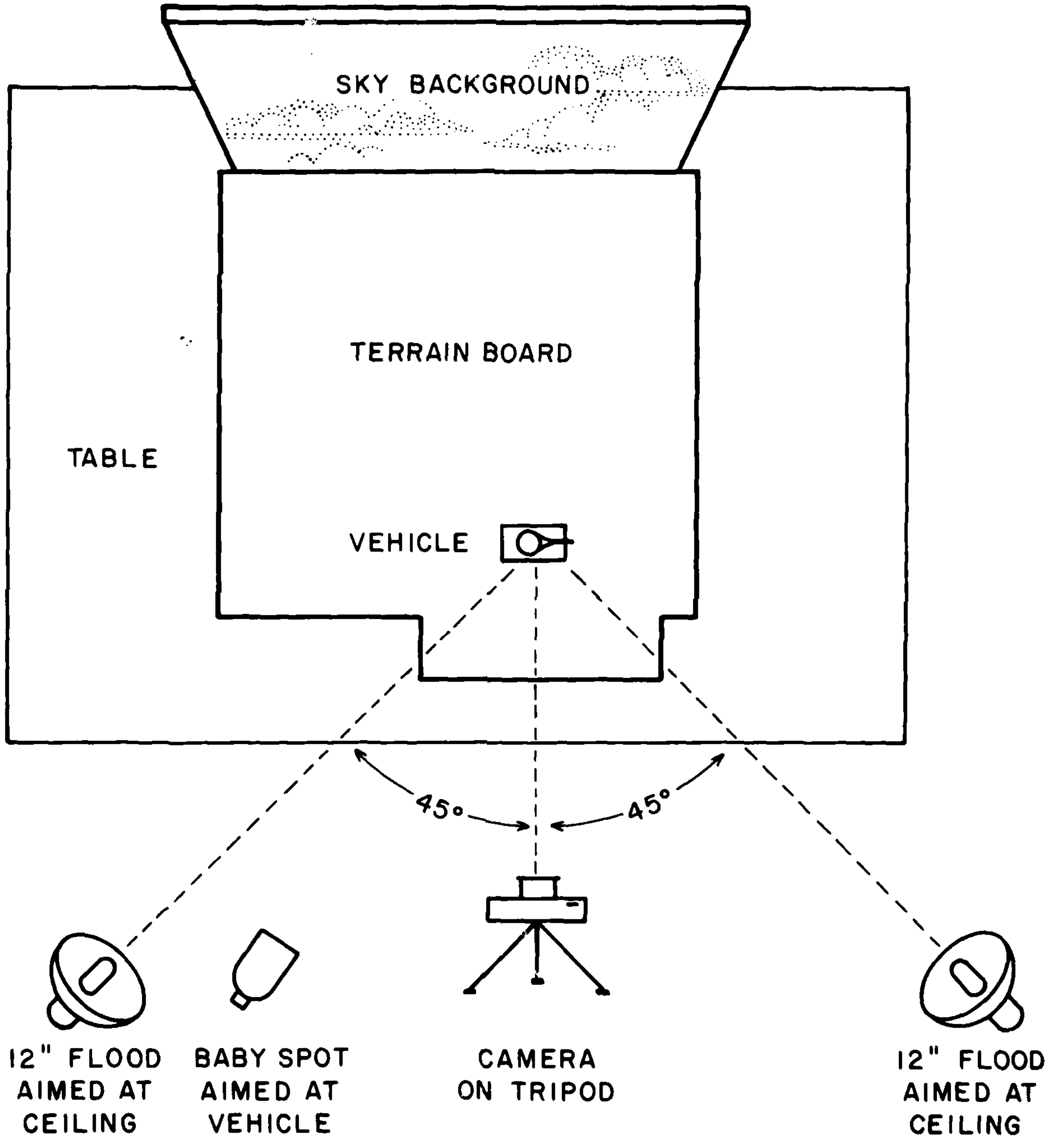

Figure 2. Vehicle Photography Layout

A primary value of the new program is that the soldier learns to focus on those vehicle characteristics which are visible at realistic combat ranges, rather than characteristics that are visible only at shorter distances.

To assure that the program teaches the soldier to differentiate between vehicles as a function of vehicle characteristics rather than terrain features associated in the photograph (slide) with a particular vehicle, the same background is used for all vehicles. All of the 25 HO scale (1:87) models were photographed in an identical location on a realistic terrain board. The fact that only 25 vehicles were used in the initial program evaluation was due to the lack of availability at that time of scale models of other vehicles. However, as additional vehicles are developed and models become available, they are being added to the CVI training program.

A more advanced CVI training program which is now being developed will include vehicles partially obscured from view by natural terrain features. The vehicles will be shown in various stages of hull and turret defilade using the same vehicles found in the basic program being evaluated in this report. A third training program in this series will use slides where only minimal recognition and identification cues are provided. Cues on these slides will be minimized by use of some of the more difficult conditions of obscuration under which recognition and identification performance can take place, e.g., use of smoke and vegetation settings.

CHAPTER IV--METHOD

RESEARCH BACKGROUND

Impetus for the current research effort in ARI came from long-standing requests for assistance from several units involved in target recognition and identification (R&I) training. In order to address this need, a well-controlled test of the basic concepts used in CVI was conducted. The feasibility of a CVI type program was tested in 1977 by administering the test program to a limited sample of helicopter pilots and gunners in the 6th U.S. Cavalry Brigade (Air Combat) under direction of a trained research team. Results of that study confirmed the feasibility of these concepts for an R&I training program.[1]

Feasibility of the basic training concepts having been established, the next priority was to incorporate those concepts into a training program which is easy to use and cost effective. The urgency for development of the present CVI program was further motivated by (1) the recognition of an Army-wide need for a standardized R&I training program which could be administered by Army personnel, and (2) the intense interest by the CG, FORSCOM in fielding the CVI training program was quickly as possible.

Given this background, the research effort presented here is better characterized as an operational evaluation of a training methodology than as a controlled laboratory experiment. The document referenced above, which demonstrated concept feasibility, is more akin to the controlled laboratory experiment. The evaluation effort described here is intended to assess the relative effectiveness of an R&I program based on those concepts when some of the control found in the laboratory environment is relaxed to facilitate administrative ease and reduce administrative costs. This report is concerned with a general assessment of the efficacy of the program developed. Evidence of program effectiveness is assessed by examining changes in soldier R&I performance following training, and from trainers' judgements about how well the CVI design and format serve as a training vehicle. Future reports will address a series of technical questions about other factors affecting R&I performance, e.g., training ranges, density, frequency, and retention following training.

RESEARCH METHOD

In order to achieve the type of operational evaluation discussed above, one CVI training package was sent to each of 22 units during April and May, 1980. Each unit, usually a division or independent brigade, was asked to incorporate the CVI training package into its R&I training program. The DCSOPS, FORSCOM assisted this evaluation effort by sending a letter to his units requesting their participation.

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[1]E. M. Haverland & J. L. Maxey. Problems in helicopter gunnery, Technical Report 78-A36, U.S. Army Research Institute for the Behavioral and Social Sciences, Alexandria, Va., December 1978.

No typical research requests were made to the units for personnel having a particular rank or MOS, age, years in service and the like. Nor was any prescription made on the number of training modules to be used. In this manner the CVI was placed in the most "normal" environment possible for its evaluation. However, each unit was required to provide ARI with the soldier practice and test answer sheets (which were part of the training itself) as well as a special Instructor's Program Evaluation Form used by the instructor to evaluate the CVI materials and technical adequacy of the package. (See Appendix A for both forms.) As discussed above, this information was used to assess the adequacy of the materials and the effectiveness of the training methodology on soldier R&I learning in an operational training environment. Results for training method/materials evaluation by instructors have been presented in terms of frequency, mean, and percent. Evaluation of the effectiveness of training on soldier R&I involved primarily the use of ANOVA designs and Duncan Multiple Range Tests.

CHAPTER V--RESULTS

ANALYSIS BASED ON OPERATIONAL AND MECHANICAL EVALUATION OF THE CVI TRAINING PROGRAM BY INSTRUCTORS

In order to assess the extent to which the training materials themselves could be employed effectively and with relative ease by military instructors, a seventeen-item questionnaire was completed by each instructor assigned to use the CVI.

Table 1 presents the ranks of those who served as instructors and filled out the Evaluation Forms.

Table 1

Rank of Instructors Giving CVI Training

	Rank								
	E-3	E-4	E-5	E-6	E-7	O-1	O-2	O-3	O-4
No. of instructors	1	1	3	5	4	4	5	2	2

n = 26

Only one evaluation was made by each instructor regardless of the number of times he taught the CVI program. The distribution is reasonably representative of the trainer population that would ordinarily be expected to give the CVI training.

Operational Evaluation

To provide the most rigorous test for the training materials, no special instructions or demonstrations were given to any military trainers. The training package was mailed to the unit. It was up to them to proceed based on the printed instructions and guidance which are a part of every training package. A point of contact with one of the civilian scientists at the Fort Hood Field Unit was identified in the training package if help was needed. No calls came. This fact could indicate that there was no difficulty with the printed materials. Table 2 confirms that most (96%) of the instructors said they had no difficulty with the instructions. They expressed similar feelings with the instructions they gave to the students; 96% said that they were clear.

Table 2

Percent Response to Direct Questions on Instructions

	Yes		No	
	N	%	N	%
Were the instructions to you clear?	25	96	1	4
Were the instructions to the trainees clear?	25	96	1	4

Additional support for the contention that the written instructions were clear is found in responses to questions related to tasks that had to be performed after reading the printed material. It is of major importance to the entire training program that instructors understand the instructions about how to position the projector, how to measure the correct distances from the screen, how to size the projected image on the screen, and how to score the CVI.

Positioning the Projector. Table 3 indicates that 88% had no difficulty in positioning the projector. Problems noted were largely related to special circumstances at local facilities. One instructor indicated difficulty in positioning the projector to avoid an upward tilt (thus distorting the image). Another instructor noted that in a small room, the projector had to be placed very close to the screen.

Table 3

Percent Response to Indirect Measures of Instructional Difficulty

	Yes		No	
	N	%	N	%
Did you have difficulty positioning the projector?	3	12	23	88
Did you have difficulty laying out simulated distances?	5	19	21	81
Any difficulty in sizing the image?	2	8	24	92
Was scoring easy?	24	92	2	8

Setting up the Classroom. To the second question in Table 3, 81% replied they had no difficulty in laying out the simulated distances in the classroom. For those who had trouble, it was related primarily to local material inadequacies. In two units the problem was not related to simulation but absence of a sufficient number of chairs; in another unit there was difficulty in making the room dark enough so slides could be seen, and still another unit noted that there was no tape measure long enough, so string was used. Again it seems obvious that lack of understanding of the instructions was not at fault.

Sizing Image on Screen. A key element that must be communicated in order to use CVI correctly is properly sizing the image on the screen. The third question in Table 3 indicates that 92% had no difficulty in sizing the image. Where difficulty was reported in two cases, the problems were related to local conditions unrelated to the instructions.

Scoring Procedure. Finally, the last question in Table 3 indicates that generally there was no problem with the scoring procedure; 92% reported no difficulty. The important point needing emphasis is that scoring is done only on Section C, the test following each module, and on module 7, the final test. The two instructors who reacted negatively observed that scoring was time-consuming. No one expressed any difficulty in understanding the instructions.

To further evaluate the printed material accompanying the CVI program, the editors at Combined Arms Center (CAC), Fort Leavenworth, Ks., reviewed these instructions from the perspective of common language usage in the military. No changes were recommended.

Except where noted, the instructional materials from both an attitudinal and performance perspective appear generally acceptable by the instructor users who responded.

Mechanical Evaluation

Slides. A serious attempt was made to produce the CVI kits as inexpensively as possible, and yet test the training concept. For example, gummed labels with the identifying characteristics for each slide were used instead of more expensive printing. It was suspected that these would not remain in place well with repeated use and would thus jam the projectors. Ninety-six percent (n = 25) of the instructors indicated that the labels were easy to read. However, as expected, several instructors (54%, n = 14) indicated that the labels did work themselves loose at the corners and thus interfered with projector operation. This is easily corrected by printing the identifying information on the slide mount.

Screen. Although the guidelines in the instructions recommended rear-view projection to eliminate potential blocking of the image by the projector with front projection, only 42% (n = 11) of the participating units used this method; 50% (n = 13) used front projection and 8% (n = 2) used other means such as a 2' x 4' piece of white cardboard. However, no serious problems due to projection method were reported.

Time Interval. A timer of some sort was required for presentation of the slides during portions of the training. As noted in Chapter II, a 15-second interval was used between slides during the training and 8 seconds during the testing. These times were selected because they are most commonly found on standard Kodak projectors with timers throughout the Army. A pilot test with the CSC 1/41 2AD, Fort Hood, prior to the distribution of the training packages to the 22 participating units indicated that the times were satisfactory. In this research, 77% (n = 20) of the instructors in this research reported the availability of projectors with the proper times on them. For the 23% (n = 6) who did not, a stop watch was used. As a field expediency this probably creates no great loss in training effectiveness, but it should not be resorted to as a common practice. The purpose of a short noninstructor controlled time interval assures standardization of training procedure and produces the mental "set" to rapidly key on significant cues and then make a response without excessive deliberation.

In order to obtain a measure of whether the interval between slides was adequate, instructors were asked: "Could you get all the description into the time allowed between slides?" Thirty-five percent (n = 9) said they had some difficulty during the 15-second automated phase. The probable cause for this problem is that the instructions were not explicit enough. More information is given than necessary in the automated section and instructors must judge what they are able to say in that period of time. Key cues which are pointed out in the written material are all they must actually include on the timed portion. There may be a tendency to try to provide more information than is in the script, thus making it impossible to complete the description in the 15-second interval. For some units with specialized missions, i.e., long-range reconnaissance or MI teams, greater detail may be required; however, the essence of the CVI training program is to train only to those cues likely to be seen at longer ranges where the detail fades. To train at near ranges (as one instructor reported) to facilitate R&I will actually make vehicle R&I at longer ranges (ranges where defensive countermeasures are possible) more difficult.[1] The cues used in R&I training at close ranges differ not only quantitatively but qualitatively from those cues used in R&I learning at longer ranges. Accordingly, instructional materials should be modified to highlight the importance of not changing the training methodology.

Vehicle Accuracy. Apart from the vehicle detail, instructors were asked to evaluate the accuracy of vehicle descriptions used in training. Sixty-seven percent (n = 17) found them satisfactory; comments from those who questioned the accuracy fell into two general categories: (1) nomenclature, and (2) detail. As discussed above, "inaccuracies" due to detail deficiencies are important only when those details would materially contribute to R&I learning at longer ranges. From this perspective, none of the reported comments concerning "detail inaccuracies" appeared relevant. Reported nomenclature errors are cited in Appendix B.

Class Size. As can be inferred from the description of the seating arrangement (see Figure 1, Chapter II) some limitations are placed on how many people can be trained at one time. Obviously, crowding is not appropriate; nevertheless, soldiers should be placed so as to limit image distortion and so

[1] W. L. Warnick & A. Kubala, op. cit.

that distance from the screen accurately simulates the ranges at which these soldiers will likely be required to recognize and identify combat vehicles. As noted above, R&I training at either shorter or longer ranges than operationally important may result in reduced R&I ability at those ranges. In the participating units, class size ranged from 4 to 40 with median size being 11 and the mean of 17. No instructors reported problems due to class size. Subject to the above considerations (room size, distortion minimization, and operational training ranges) class size appears unimportant.

Effectiveness of Training. Finally, instructors were asked to indicate whether they felt the training was effective. Sixty-nine percent (n = 18) rated it very effective, 27% (n = 8) effective, and 4% (n = 1) uncertain.

ADDITIONAL INSTRUCTOR COMMENTS

A number of useful observations were given in the "Additional Comments" section of the Instruction Evaluation Form. (See Appendix B for complete list.) Some of the more important observations are discussed below.

CVI Package Increased to Meet SQT Requirements

A frequent observation by many instructors was that the CVI Training Program method was excellent but there should be closer coordination between selection of vehicles for CVI Training and the Skill Qualification Test (SQT) portion on vehicle identification. The 25 vehicles in the Basic CVI program were selected from a list of 45 vehicles which the S-2 and Threat Team of the 6th U.S. Cavalry Brigade (Air Combat) recommended for inclusion in the original training program. The 25 vehicles finally selected were chosen because they were in other Cavalry SQTs at that time and because their availability in HO (1:87) scale permitted slides used in the CVI training program to be made. At this writing a number of additional vehicles are being selected for construction to add to the basic program. Those chosen will be based on decisions made by the Combined Arms Center (CAC) which is now the proponent for recognition in the Army. It is clearly important that the list of vehicles selected should have some standardization based on realistic assessments of what is critical and how much the soldier can be expected to know. Finally, tests must measure knowledge of this standardized list.

CVI Should Include Vehicles Under Degraded Conditions

Another comment indicated that the vehicles should be presented under degraded conditions of visibility, i.e., hull and turret defilade, smoke, vegetation, and terrain. At present, advanced CVI training modules are being developed which take these requirements into account. Some modules are expected to be completed by mid-1981. Other variations are being considered at present, including thermal imagery training, stabilized gunnery training and presentation of formations of vehicles using motion pictures.

Frequency of Training

Several instructors felt that no more than two modules should be completed at one training period. However, several other units gave all seven modules in a 2-day period. Since the effects of training density (modules/days) on soldier training and retention have not yet been evaluated experimentally, at this time it is best to plan training density based on training time available and the motivational level of the unit. Sufficient breaks to reduce fatigue are necessary. In special cases such as the Organized Reserves and National Guard, where training takes place over a weekend, or with highly motivated units, all seven modules have been given in a 2-day period of time without any complaints from the soldiers. In general, a good rule of thumb would be to limit training to two modules per training period.

Module 7 as a Diagnostic Test

As a rule, if a unit is able to begin a systematic training program for CVI, Module 7 (Overall test module) should be given initially to determine which troops need training on what vehicles.

Providing Printed Material for CVI Training

Reproduction of the work sheets from the Instructor's Guide, (see Appendix A), adds a burden on some units whose budgets or access to reproduction facilities are limited. It is felt that requiring the soldier to make active responses through the use of the work sheets in training will motivate the soldier, make him a more active participant in the learning process, and add kinesthetic feedback to supplement the aural and visual feedback in training. If the soldier foregoes the requirement to make a written response each time, a reduction in the rate of learning and in subsequent retention can be expected. Therefore, instructions should be included in Appendix A, Instructor's Guide of the CVI Training Program which tell the unit trainer how to get the needed forms printed through his local training support office, or preprinted forms should be provided by the Army.

Timing on Module 7

Some instructors found that soldiers had difficulty with Module 7 (final test) because they could not keep the vehicle and the space on the answer sheet synchronized. Soldiers would lose their place and make responses in the wrong spaces on the answer sheet. To correct this problem it is suggested that numbers be put on the slide image itself (for test Module 7). The large number of slides in the updated basic CVI program (60 slides, 30 vehicles, 2 views of each) decreases the change that a "key" can be learned. If R&I training reaches a point where it is desirable to include the CVI test as part of the SQT, ARI can assist in the development of alternate sets of CVI tests.

Who Should Get a CVI Training Package

Most comments received from instructors suggested distribution of the CVI Training Program down to battalion level. The ARI Fort Hood Field Unit Research and Development Coordinator independently received the same recommendation in conversation with the points of contact in each unit.

ANALYSIS BASED ON PERFORMANCE SCORES ON THE CVI TRAINING PROGRAM

Composition of the Data Base

Twenty-two different units were provided with the CVI Training Program. They were located primarily in FORSCOM and TRADOC but USAREUR as well as U.S. Air Force and Marine Corps also participated. Table 4 shows the units and the number of soldiers from whom training worksheets and module tests were received in time to be included in this report. As noted in Table 5, several units that received the training package have not as yet returned the module tests for ARI evaluation. For each nonresponding unit, contact was made with designated points of contact for CVI in each unit. Review of a log of contacts with these units kept by the Fort Hood ARI R&D Coordinator reveals that in no case was failure to respond due to lack of understanding of the value of CVI or any difficulty in using the training program as described. For some units, curriculum adjustments could not be made to accommodate CVI training within the research time frame. Several other units provided data which for one reason or another were incomplete. Still other units experienced rapid personnel turnover and coordination for use of the CVI program was lost. However, a sufficiently large number did provide these materials, so that an initial analysis is possible. It is apparent from Table 4 that not all units gave the entire CVI training package; some gave only one module, others gave all seven modules. Only data from U.S. Army units were used for this report.

Analysis of Performance Scores[2]

The best design for testing the effectiveness of CVI training is to compare it with an alternate system. Several training techniques which employ mini-ranges and model vehicles exist, but these methodologies require an investment of time (organizing and moving troops to the training area) and money (equipment costs). Simply on the basis of cost, these techniques can be eliminated from consideration for Army-wide use. At this time no training system comparable to CVI exists which would provide a reasonable basis for comparison.

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[2] No attempt is made in this report to interpret all findings detected from analyses presented in Appendix C; only those findings which were judged to affect either the technical or operational feasibility of CVI are discussed here. More detailed discussion of those less important relationships will be considered in the next report.

TABLE 4

ARMY UNITS THAT RETURNED USEABLE DATA

Units Participating	Number of Soldiers Completing Each Module: 1	2	3	4	5	6	7* PRE Test	7* Post** Test	Total Number of Modules completed: Each Unit
1st CAV Div 2/5 XM1 Test Bn	50	48	45	45	46	46	97	45 (38)	422
2nd Armor Div	37	27	47	28	10	1	0	0	150
1st INF Div	54	9	28	49	74	68		36	318
3rd ACR	92	85	46	51	29	10		9	322
7th Army Training Command	12	12	12	0	0	0	0	0	36
82nd Air Borne Div	3	3	3	3	3	3	0	2 (2)	20
24th Infantry Div	20	24	11	12	11	9	0	10 (8)	97
5th Infantry Div	28	27	29	29	29	28	0	29 (27)	199
5th Army 180 Inf Oklahoma National Guard	15	15	15	15	14	16	0	15 (12)	105
Modules Completed: All Units	311	250	236	232	216	181	97	146 (87)	1669

* Pretest modules were cases where MODULE 7 was administered prior to any training modules (Modules 1-5); post test modules were cases where MODULE 7 was administered after at least one training module was used.

**Number of subjects included in post test analysis group are shown in parenthesis.

TABLE 5

UNITS THAT HAVE CVI

FORSCOM UNITS

* 1st I.D.
* 1st CAV
  G-2
  2/5 XM1 Tank Bn.
* 2nd AD
  4th I.D.
* 5th I.D.
  7th I.D.
  9th I.D.
* 24th I.D.
* 82nd Airborne Division w/82nd CAB
  101st Airborne Division
  193rd I.B.
  1st Readiness Region
* 3rd ACR
* 5th Army (2d BN (TOW) 180th INF.)
  (Oklahoma National Guard)
  Readiness Group VII

TRADOC UNITS

Fort Benning, GA.
Fort Huachuca, AZ.
Fort Knox, KN.
Fort Sill, OK.

OTHER

* 354th Tactical Fighter Wing (Air Force)
* Supporting Arms Instruction Division
  (U.S. Marine Corps)

* Units that returned usable data within time constraints of the research schedule.

Comparison of CVI with Present Training. One method of evaluating the CVI program is to determine the program's training utility compared to whatever may now exist. Work done early in CVI development showed that attack helicopter pilots presumably fully trained in vehicle recognition and identification showed marked improvement after training on the prototype version of the CVI program.[3] In order to further evaluate the value of CVI training, two analyses were done to compare the module 7 performance of soldiers who received all five CVI training modules vs. soldiers who received no training on those modules. Module 6 is not included for this analysis because it is a repetition of vehicles in one of the first five modules. Both groups are presumed to have received some non-CVI training since it is included in AIT and is a part of training in all combat units. Two analyses were made. One examined the differences between the two groups on recognition (required the soldier to indicate whether the vehicle is friend or foe) (Appendix C, Table C1) and a second compared performance on identification (required the soldier to give the correct name or designation of the vehicle) (Appendix C, Table C2).

Recognition being the easier of the two tasks, it might be expected that training now in use throughout the Army would be satisfactory and there would be no difference between the two groups. However, the analysis (Appendix C, Table C1) indicated that the difference between those with CVI training and those with other types of training was indeed large enough to be statistically significant ($F = 6.07$, $p < .02$). Comparison of recognition performance means for these two groups indicates that those soldiers receiving the CVI training modules performed better (32.78 vs. 29.19; see Table 6 below).

Table 6

Means and Standard Deviations for Recognition Scores on Module 7 for Soldiers not Trained on CVI and Soldiers Trained on CVI

	N	Mean	Standard deviation
No CVI training	97	29.186	6.88
CVI training	87	32.782	12.40
Maximum score possible		50	

Significant differences in recognition performance on different vehicles were also found ($F = 13.16$, $p < .001$, see Table C1, Appendix C). This simply says that it is more difficult to recognize some vehicles than others regardless of whether training is on CVI or some other method. Comparison on each group by vehicle indicates significant differences exist ($F = 6.05$, $p < .001$, see Table C1, Appendix C). From inspection of means (Appendix D, Table D1) the

[3] E. M. Haverland & J. L. Maxey, op. cit.

CVI trained group recognition performance is superior to the non-CVI trained group for 16 vehicles; of the remaining 9 vehicles, 6 are threat vehicles. Non-CVI training in the non-CVI trained group may have more strongly emphasized recognition of threat vehicles.

As expected, identification performance means of the two groups differ significantly ($F = 60.33$, $p < .001$, see Appendix C, Table C2). Comparison of identification performance means for these two groups (Table 7 below) indicates that those soldiers receiving the CVI training modules have performed better (19.45 vs. 6.47). As with recognition performance, vehicles appear to have inherent characteristics which cause significant differences in vehicle identification difficulty ($F = 25.66$, $p < .001$, see Appendix C, Table C2). While CVI-trained identification means are higher than corresponding pretest means of non-CVI-trained soldiers for each vehicle (Appendix D, Table D2), the amount of these differences is not equal for each vehicle ($F = 8.40$, $p < .001$, see Appendix C, Table C2).

Table 7

Means and Standard Deviations for Identification Scores on Module 7 for Soldiers not Trained on CVI and Soldiers Trained on CVI

	N	Mean	Standard deviation
Not trained on CVI	97	6.470	9.41
Trained on CVI	87	19.448	13.11
Maximum score possible		50	

Results cited in Tables C1 and C2 in Appendix C comparing CVI- and non-CVI-trained test performance of different (independent) groups of soldiers on module 7 strongly suggests that soldiers receiving CVI training in addition to any training normally provided by their unit show significantly improved R&I performance.

As discussed in Chapter IV, units were given freedom to utilize the CVI as part of the usual training process. Since only one unit utilized the diagnostic possibility by pretesting soldiers (see Table 4), differences in type (quality), recency, and quantity of non-CVI training provided to units in each group could have existed. Since the presence of such differences could have led to drawing erroneous inferences from Tables C1 and C2, these analyses were repeated for CVI-trained and non-CVI-trained (independent) groups only from the 1st Cavalry Division. Results generally concurred with those presented in Tables C1 and C2 for all units.[4] Further, when the CVI-trained Module 7 test recognition and

[4] These supporting analyses are not included in this report, but may be obtained by the interested reader upon request.

identification performance of soldiers from the 1st Cavalry Division was compared with performance of CVI-trained soldiers from other units, no overall differences in performance were detected and the pattern of recognition performance of the two CVI-trained groups on each vehicle was similar; however, differences in the pattern of identification performance on different vehicles by the two CVI-trained groups was detected.[5] Taken together these findings are consistent with the inference that neither the differences in quality, quantity, or the recency of non-CVI training that may have existed in different units was important enough, when combined with CVI training, to differentially affect recognition performance. However, some differences in emphasis during non-CVI training for vehicle identifications may exist between units. Generally these supporting analyses point to the validity of conclusions drawn from Tables C1 and C2 cited above.

Comparison of Performance on Different Modules. Are the modules, as constructed, of approximately equal difficulty? In order to answer this question, analyses were done to compare recognition and identification performance on modules 1-5 (see Appendix C, Tables C3 and C4). Module 6 is considered later in this report because it includes vehicles (found in modules 1-5) which were judged difficult to learn when CVI was planned.

Results of the recognition analyses indicates significant differences in recognition performance among modules ($F = 5.97$, $p < .001$, see Appendix C, Table C3). In identification performance no significant differences among modules were present ($F = 2.02$, N.S., see Appendix C, Table C4). Means and standard deviations of recognition and identification performance for each vehicle trained in modules 1-5 is in Appendix D, Table D3; means and standard deviations for recognition and identification performance over modules 1 through 5 are in Table 8 below.

Table 8

Means and Standard Deviations
for Recognition and Identification Scores for Module 1-5 Tests
(3 views)

	N	Mean	Standard deviation
Recognition	87	67.32	10.83
Identification	87	63.33	14.37
Maximum possible score		75	

In order to determine which module means differ significantly in recognition performance a Duncan Multiple Range Test was used (Table 9).

[5] Ibid.

Table 9

Rank Order of Recognition Performance
Based on Means for Each of the Five Training Modules*

(Module) Mean	(4)	12.85	(3)	13.30	(1)	13.38	(5)	13.40	(2)	14.39

*Means underlined by a common line do not differ significantly from each other (p = .05). An overall test on identification performance module means was not significant. (F = 2.02, p < .05. See Table C4, Appendix C.)

From Table 9 it is seen that mean module recognition performance for modules 4 and 2 differ significantly from each other as well as the other three modules; mean recognition performance for modules 3, 1, and 5 do not differ significantly from each other.

Based on these analyses, it appears that the modules are generally equal in identification difficulty but marked differences exist in recognition. Module 2 is composed of all vehicles which are friendly. Soldiers undergoing training probably recognized during the manual and automated presentations that no threat vehicles were included. Such a recognition would quite naturally lead soldiers to respond "Friend" to each vehicle presented in the module test.

The poorer recognition performance for module 4 (Table 3) may be a statistical artifact attributable primarily to the relatively small behavioral variability reported (see Table C3, Appendix C). Small mean differences are more likely to be significantly different when variability is low. In addition, inspection of performance on the vehicles in module 4 reveals that four of the five ranked in the top 40% for difficulty; two held ranks of 1 and 4.

Differences in recognition difficulty of Module 2 are leading to the modification of that module to include two threat and only three friendly vehicles. Until further evaluation clearly indicates the relative difficulty of learning to recognize vehicles included in Module 4, no modification of that module is now recommended. Forthcoming research aimed at gaining estimates of learning difficulty for each vehicle independent of the other vehicles included in the modules is being planned.

<u>Comparison of Performance on Different Vehicles</u>. Earlier analyses (Appendix C, Tables C3 and C4) indicated that there were significant differences in performance among vehicles. In order to better understand the relative difficulty in learning to recognize and identify each vehicle, Duncan Multiple Range Tests of mean scores for the 25 vehicles in the basic training modules (1-5) were used; one for recognition (Appendix E, Table E1) and another for identification (Appendix E, Table E2). From the matrices presented in that Appendix, it is possible to determine for any given vehicle whether or not it is significantly more difficult to learn than any other vehicle. For example, the AMX30 (2.287) is the most difficult vehicle to learn to recognize among the array of 25 vehicles while the M60A1 and M109 are most easily learned (2.920 and 2.966).

Results in these matrices will be used together with "confusion matrices" in the next report to help assess the need for development of an intermediate CVI program. Confusion matrices will indicate in greater detail the nature of incorrect responses which have occurred.

Comparison of Performance During Training and on Final Test. As originally conceived, the training modules (1-5) were designed to provide the soldier with an amount of information which they would be capable of learning in a relatively short period of time. It is important, however, to remember that this training methodology should produce a soldier who can recognize and identify combat vehicles in the battlefield environment with all its complexity. As such, performance on the training modules, because they contain only 5 vehicles, simulate the battlefield environment with a much lower degree of fidelity than the module 7 test which has 25. With this distinction in mind, it seemed appropriate to compare both recognition and identification performance during the training modules with performance on module 7. Overall performance is summarized in Table 10.

Table 10

Means and Standard Deviations for Recognition and Identification Scores on Module 1-5 (2 views) vs. Module 7

	Recognition			Identification		
	N	Mean	Standard deviation	N	Mean	Standard deviation
Module 1-5	87	44.48	7.43	87	41.74	9.73
Module 7	87	32.78	12.40	87	19.45	13.11
Maximum possible score		50			50	

In order to conduct this evaluation two analyses were performed; one for the recognition scores (Appendix C, Table C5), another for identification scores (Appendix C, Table C6). A significant difference was found between recognition of vehicles in the training modules (1-5) and test module 7 (F = 103.81, p < .001, see Appendix C, Table C5); identification performance showed a similar difference (F = 296.52, p < .001, Appendix C, Table C6). As expected, the mean recognition and identification scores for module 7 are generally lower across all vehicles (Appendix C, Table C6 and C7). For the unit trainer, lower performance on a higher fidelity measure of combat readiness should serve to reemphasize the importance of establishing performance criteria based on final test (Module 7) performance rather than on the training modules. For the training planner this information implies that retraining will probably be required to maintain combat ready R&I performance. This problem will be addressed in the third report of this research.

Effect of Vehicle View on Performance. During training (modules 1-5), each vehicle was presented in three of five different views; front, oblique right and left, and side right and left. The modules were balanced in a way that generally equalizes the presence of the views. Studies by Warnick and Kubala; Haverland and Maxey; and Warnick, Chastain, and Ton all found that the front view is most difficult, an oblique view is of moderate difficulty, and the side view is least difficult. Appendix F (Tables F1-F2) shows the balancing that was used in CVI to limit undue bias based on view among modules. Appendix G (Tables G1-G3) presents the mean performance for recognition and identification score on the final tests for each module by vehicle view. In general it appears from inspection of these findings that differences in view difficulty parallel findings in the studies reported above. Detailed analysis of these data will be done in the second report since this information is not critical to the objectives of the present report.

Effect of Vehicle Grouping on Performance. Training modules 1 through 5 contained all 25 vehicles used in the CVI program. However, in order to obtain a preliminary indication of how much R&I performance is affected when vehicles judged to be very similar are combined in a module, a sixth (experimental) module was formed. It was expected that combining similar vehicles would make the discrimination required more difficult. In order to test this hypothesis, analyses comparing soldiers R&I performance in the training modules (1-5) and after training in module 6 were performed (Appendix C, Tables C7 and C8). Even though training in module 6 followed training on the same vehicles in the training modules, recognition performance in module 6 was significantly poorer ($F = 6.86$, $p < .01$, Appendix C, Table C7); similar findings were found for identification performance, ($F = 5.64$, $p < .01$, Appendix C, Table C8). Means and standard deviations for each vehicle are summarized in Appendix D (Tables D6 and D7). Overall performance is summarized in Table 11 below. Since performance was significantly poorer in module 6 even following training of the same vehicles in other modules, it appears that not only do vehicles have inherent characteristics that produce difficulty in learning, but that the context (set of other vehicles) in which the vehicle is trained can also affect the estimates of difficulty. Had the vehicles not been trained in the training modules, it is likely that module 6 performance would have been far poorer. As indicated above, research is planned to obtain estimates of vehicle learning difficulty which is less dependent on the learning context.

Table 11

Means and Standard Deviations for Recognition and Identification Scores on Module 1-5 vs. Module 6

	Recognition			Identification		
	N	Mean	Standard deviation	N	Mean	Standard deviation
Module 1-5	89	13.06	2.37	89	12.12	3.59
Module 6	89	12.26	3.01	89	11.38	3.58
Maximum possible score		15			15	

CHAPTER VI--CONCLUSIONS

GENERAL RECOMMENDATIONS

The following are general observations that came from almost every unit and are of major importance to any planning for R&I training in the military service today.

The basic Combat Vehicle Identification (CVI) Training Program has achieved at this point in its development five of its seven stated objectives. They are:

- Train soldiers to recognize primarily those cues important at realistic combat ranges for vehicle identification;
- Keep training simple with a minimum of support materials;
- Be modular in design and useable in short training periods;
- Be adaptable for use in simulation of any potential optic/distance requirements; and
- Produce high levels of motivation and learning in a short period of training.

The last two objectives will be met if TRADOC elects to implement the program. They are:

- Standardize training for R&I in the Army, and
- Provide an ongoing measure for evaluating R&I training skills.

The data analysis of performance scores indicate that CVI training, when viewed against the backdrop of the wide variety and quality of R&I training now being received by units, leads to significant improvement in R&I performance.

Recognition recall is significantly better than identification recall, i.e., soldiers find it easier to learn to recognize a vehicle as friendly or threat than to give a name or number for the vehicle.

Soldier retention for R&I after a single exposure to the CVI program becomes degraded after a period of time. To maintain high skill levels with large numbers of vehicles may require frequent retraining (no matter what the training program may be). Data on learning decay and required schedules for retraining are now being collected.

"Training that leads to higher scores on performance tests, which in turn determines promotions, etc., will be more likely to be used on a regular basis." That is the sentiment of most unit trainers involved with the CVI training program. Hence, R&I training of combat vehicles must encompass those elements that are required in Army-wide testing practices such as the SQT and AGI. Standardization throughout the Army of R&I training is needed.

To gain such standardization, a procedure which determines what vehicles must be learned and by what groups of people is essential. Once these two elements have been identified, a technology such as that in the CVI program can be implemented on a standardized Army-wide basis.

Presently the ARI Field Unit at Fort Hood, Tex., is working toward a proven training technology that will make R&I training and Army-wide testing programs compatible. Additional vehicles can be constructed to increase the present number of modules in the CVI training program when CAC, R&I proponent, determines which vehicles should be included in the basic CVI training program.

It has been recommended by the units using CVI or familiar with it that once the CVI program is produced by TRADOC, distribution should be down to battalion level in the active Army and selected units of the reserve components.

It is recognized that various groups may have special requirements for R&I training and there may be a tendency for units to want to reorganize the standard modules in CVI. However, it is recommended that the modules in the basic CVI package remain intact, i.e., that units be instructed to make no changes in the composition of the modules. While a solution to the problem of what vehicles should be included for what groups is being prepared, it is important to implement a basic program such as CVI training which is standardized and to be certain an effective program is in operation.

The second CVI training package, to be completed in 1981, may be the appropriate place to consider what grouping of vehicles would be best for specialized training, since the timing will coincide with CAC's determination of what vehicles are to be used.

SPECIFIC CVI PROGRAM MODIFICATIONS

Changes Being Made in the Prototype

A series of minor modifications to the CVI program were identified by the field tests. They fall into two categories. The first includes changes that have been incorporated in the prototype. The following is a list of those changes.

1. Six vehicles have been added to extend the present array. They are the XM1, BMP, BRDM-2, ASU-85, BMD, and M1974.

2. The Sheridan, M551, has been removed.

3. The BTR 50 has been rephotographed with the human figures removed.

4. The five new vehicles will allow for an additional module with the necessary training materials furnished. This revised basic CVI program now consists of 30 vehicles, 5 in each of 6 modules with the seventh module remaining as the training program test. (The experimental module 6 in the prototype, composed of only tanks, has been removed.)

5. Module 2 has been changed to include two of the new threat vehicles in order to increase the difficulty of the module.

Changes to be Made at Time of Production

The second category of modifications involves changes in training material that should be incorporated at the time of quantity production by TRADOC. This list follows:

1. Because identification labels on each slide mount loosen after frequent use, this information must be printed on the slide mount.

2. The Work Sheets the soldiers use during training require a large amount of reproduction and a drain on local resources. Assigning the Work Sheets a Department of the Army Form number would be useful so they can be produced at large plants and ordered by local units.

3. The slides in final test module 7 should have sequential numbers placed on the slide along with the vehicle image to prevent soldiers from losing their place on the answer sheet.

APPENDIX A.

INSTRUCTOR'S PACKAGE

- Table for Simulated Distance/Optics
- Soldier Work Sheets
- Instructor's Program Evaluation Form
- Technical Description of the CVI Slide Production

TABLE 1

EYE-TO-SCREEN VIEWING DISTANCES* FOR LARGE ROOMS

Simulated Range (meters)	no optic	Distance From Screen to Trainees' Eyes 6X optics	7X optics	8X optics	10X optics	13X optics
250	18'10"	---	---	---	---	---
500	37'9"	6'3"	5'5"	---	---	---
750	---	9'5"	8'1"	7'1"	5'8"	---
1000	---	12'7"	10'9"	9'5"	7'7"	5'10"
1250	---	15'9"	13'6"	11'9"	9'5"	7'4"
1500	---	18'10"	16'2"	14'2"	11'4"	8'8"
1750	---	22'0"	18'10"	16'6"	13'2"	10'2"
2000	---	25'2"	21'7"	18'10"	15'1"	11'7"
2250	---	28'3"	24'3"	21'3"		
2500	---	31'5"	26'11"	23'7"	18'10"	14'6"
2750	---	34'7"	29'8"	25'11"	20'9"	15'11"
3000	---	37'9"	32'4"	28'3"	22'8"	17'5"
3250	---	---	35'0"	30'8"	24'5"	18'10"
3500	---	---	37'9"	33'9"	26'5"	20'4"
3750	---	---	---	35'4"	28'3"	21'9"
4000	---	---	---	37'9"	30'2"	23'2"

*Practical viewing distances are from 5 to 40 feet. Few people can be expected to consistently identify vehicles beyond 40 feet under these conditions.

Date: ____________
Module No. ________
Optical Power ______
Range ____________

BASIC COMBAT VEHICLE IDENTIFICATION (CVI) TRAINING PROGRAM

Modules 1-6

SOLDIER INFORMATION

1. Name: ____
(Last) (First) (MI)

2. Rank: ____________________ 3. ASN: ________________

4. Age: ____________ 5. Military Unit: ________________

6. Time in Service: __________ __________
(Years) (Months)

7. MOS: ____

8. Length of time in MOS: __________ __________
(Years) (Months)

9. What is the MOS of the job to which you are currently assigned?

____

10. Do you wear glasses (including contact lenses)?
Yes ____ No ____

(If you checked YES, complete 10a and 10b below.)

10a. Do you wear glasses (or contact lenses) on the job?
Yes ____ No ____

10b. Do you wear glasses (or contact lenses) only for reading?
Yes ____ No ____

Module No. ______
Optical Power ____
Range __________

SOLDIER WORK SHEET

SOLDIER NAME ____________________________ RANK __________

MODULES 1-6

Section A: Manual Presentation Sequence

Trial	Friend/ Threat	Vehicle Description	Trial	Friend/ Threat	Vehicle Description
1			14		
2			15		
3			16		
4			17		
5			18		
6			19		
7			20		
8			21		
9			22		
10			23		
11			24		
12			25		
13					

Module No. ______
Optical Power ____
Range ________

SOLDIER WORK SHEET

SOLDIER NAME ______________________ RANK ________

MODULES 1-6

Section B: Manual Presentation Sequence

Trial	Friend/ Threat	Vehicle Description	Trial	Friend/ Threat	Vehicle Description
26	______	__________	39	______	__________
27	______	__________	40	______	__________
28	______	__________	41	______	__________
29	______	__________	42	______	__________
30	______	__________	43	______	__________
31	______	__________	44	______	__________
32	______	__________	45	______	__________
33	______	__________	46	______	__________
34	______	__________	47	______	__________
35	______	__________	48	______	__________
36	______	__________	49	______	__________
37	______	__________	50	______	__________
38	______	__________			

Module No. ________
Optical Power ______
Range ____________

SOLDIER ANSWER SHEET

Soldier Name ____________________ Rank ____________

MODULES 1-6

Section C: Module Test (Automated)

(8 second exposure)

Trial	Friend/Threat	Vehicle Description
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

Date: ____________
Optical Power ____
Range ____________

SOLDIER ANSWER SHEET (PAGE 1)

SOLDIER NAME ________________________ RANK ___________________

MODULE 7

Final Test

Trial	Friend/ Threat	Vehicle Description	Trial	Friend/ Threat	Vehicle Description
1	______	___________	14	______	___________
2	______	___________	15	______	___________
3	______	___________	16	______	___________
4	______	___________	17	______	___________
5	______	___________	18	______	___________
6	______	___________	19	______	___________
7	______	___________	20	______	___________
8	______	___________	21	______	___________
9	______	___________	22	______	___________
10	______	___________	23	______	___________
11	______	___________	24	______	___________
12	______	___________	25	______	___________
13	______	___________			

Date: ____________
Optical Power ____
Range ____________

SOLDIER ANSWER SHEET (PAGE 2)

SOLDIER NAME ________________________ RANK ___________________

MODULE 7

Final Test

Trial	Friend/ Threat	Vehicle Description	Trial	Friend/ Threat	Vehicle Description
26	______	___________	39	______	___________
27	______	___________	40	______	___________
28	______	___________	41	______	___________
29	______	___________	42	______	___________
30	______	___________	43	______	___________
31	______	___________	44	______	___________
32	______	___________	45	______	___________
33	______	___________	46	______	___________
34	______	___________	47	______	___________
35	______	___________	48	______	___________
36	______	___________	49	______	___________
37	______	___________	50	______	___________
38	______	___________			

COMBAT VEHICLE IDENTIFICATION TRAINING PROGRAM

INSTRUCTOR'S PROGRAM EVALUATION FORM

Name of Unit ___________________ Instructor ________________ Rank____________

In order to evaluate this training it is 'mportant that we learn from you, the instructor, all we can about the CVI Program. We would appreciate your honest and thoughtfui responses to the following questions.

1. Were labels on the slides easily read? Yes _____ No _____
   If no, explain ____

2. Did the slides jam? Yes _____ No ______

3. What type of projection screen was used? Front projection _____
   Rear projection _____ Other _____

4. How many people would the classroom seat? _____

5. How many people were in your class? _____

6. Did you have difficulty positioning the projector? Yes _____ No _____
   If yes, explain ____

7. Did you have difficulty laying out simulated distances? Yes___ No ____

   ____

8. Any difficulty in sizing the range? Yes _____ No _____

   ____

9. Was scoring easy? Yes __ _ No _____
   If no, explain ____

10. Any difficulty with accuracy of vehicle descriptions? Yes____ No ____
    If yes, explain ____

11. Could you get all the description into the time allowed between slides? Yes _____ No _____
    If no, explain____

12. Were the instructions to you clear? Yes _____ No _____
    If no, explain ____

13. Were the instructions to the trainees clear? Yes _____ No _____
    If no, explain ____

14. Did you have trouble getting a projector with an 8 and 15 second timer: Yes ____ No ____

15. If your projector did not have a timer, what did you use? __________

____

16. How would you rate the effectiveness of this training?

____ Very effective
____ Effective
____ Neither effective nor ineffective
____ Ineffective
____ Very ineffective

17. Are there any comments about the training program you would like to add? ____

____

____

Point of contact: Dr. Norman D. Smith, ARI Field Unit, Fort Hood, AV 737-9826

TECHNICAL DESCRIPTION OF CVI MASTER SET SLIDE PRODUCTION

A group of 25 HO scale model vehicles was obtained and each painted with the same camouflage pattern. These vehicles were placed one at a time in each of five positions (side right, side left, oblique right, oblique left, and front) on a 30"x30" HO scale terrain board with a sky background airbrushed onto a 20"x28" piece of cardboard.

Lighting was provided by an Ascor "Producer" Electronic Flash Model 3302-03 with two 12" floodlights and a baby spot. The floodlights were set at 45° to each side of the camera lens axis and aimed at a matte-white ceiling to give even diffused lighting over the entire terrain board and sky background. The baby spot (no lens) with a diffuser over the front was set between the left floodlight and the camera a little above the terrain board level and aimed at the vehicle as fill.

The "medium" setting was used on the power supply to give approximately 166 watt-seconds per lamp.

Exposures of 1/60 second at f/f.6 were made on Kodak Ektachrome 64 Professional Film (EPR 135-36: exposure index of 64) with a Nikon 35mm camera, Nikkor 50 mm f/1.4 lens, and 81A filter.

APPENDIX B

COMMENTS MADE BY INSTRUCTORS

COMMENTS

2. Did the slides jam? Yes ___ No ___

   Yes. Sticker labels jammed.

   Yes. Marking tape peels and holds slides.

   Yes. Heated up labels curled and jammed in projector.

   Yes, the slides jammed quite often due to identifying tabs attached to each slide.

   Yes. Slide 7-13

   Yes. Labels came loose and caused jams.

6. Did you have difficulty positioning the projector? Yes ___ No ___.

   Yes, Tried to follow instructions that say don't leave projector tilted upward. Upward tilt shows distortion.

   Yes. For a small room the projector must be placed very close to screen.

   Yes. Rear projection would be optimum.

7. Did you have difficulty laying out simulated distances. Yes ___ No ___.

   Yes. Shortage of chairs while 2 modules were taught simultaneously.

   Yes. Lack of chairs made accurate distancing difficult.

   Yes. The room wasn't large enough. The only room large enough we weren't able to close out the light.

   Yes. Did not have long tape measure. Used string taped with measured increments.

9. Was scoring easy? Yes ___ No___.

   No. Too time consuming.

   No. Time consuming to grade all modules and final test.

   Yes. But very time consuming.

   Yes. Took awhile to grade.

9. Was scoring easy? Yes ___ No ___.

No. It was difficult to monitor the activity; we traded papers to score each other.

No. What is pass? What is fail?

10. Any difficulty with accuracy of vehicle descriptions? Yes ___ No ___.

Yes. BTR 60P not a P. P has a covered top, 4 hatches 2 MG (I belive)

Yes. Models tend to leave out some of the exact features.

No. Model of M-48 not accurate. Turrent area.

Yes. T-64 was termed a T-72.

Yes. T-64 was termed a T-72.

Yes. Distinguishing between threat (Russian) tanks created problems.

Yes. Slide 2-5; Cal .50 MG, Slide 4-11; 4 Roadwheels or 5.

Yes. What looks like a beetle may not look like a beetle to others.

11. Could you get all the description into the time allowed between slides? Yes ___ No ___.

No. On 15 sec section I had to start talking before students had time to think.

No. Used more time for descriptions, comments, etc.

NA Module # 7

No. Description was accurate but long.

No. Description elaborate and overly long.

No. Auto presentation sequence too far to include all description.

No. During automatic presentation, instructor was forced to delay slides.

No. Section B. Necessary to pick and choose the valuable points.

No. Too much information for the time alloted.

No. 15 seconds is not very long.

COMMENTS TO THE QUESTION:

" Are there any comments about the training program you would like to add?"

Too long/5 showings of ea. vehicle in initial phase is excessive and boring/3 is sufficient. Although the content is good, if it were directed toward SQT requirements it would be more effective for the troops.(i.e use only vehicles required for ID by SQT Manual) Instructions could give more detail on difference between certain vehicles; the AMX 30-T72/Scorpion and Scimitar. A good variation/training method would be to use two projectors putting up views of similar vehicles at same time to compare! Also to enhance realism we had those who cared to smoke sit in the front row. The cigarette smoke simulated battlefield smoke and made ID more challenging.

Initial observations of Module 1 were quite impressive. It not only will reinforce trainer knowledge but also the instructor. Use of slide is a viable asset and should be conducted with more frequency. TEC tapes degrade the instructor participation the CVI course allows for instructor input.

At long ranges, I don't feel the difference between the Scorpion and Scimitar are worth stressing.

I would like to see the answers require name of vehicle and country. The models lose a lot in exact detail and realism. I wonder why some exact vehicles cannot be used at different distances. Slides on Final Test #7 should be numbered so personnel being tested do not lose count of question on test.

The program is probably the most realistic and applicable training for identifying vehicles on the modern battlefield. It is interesting and effectively teaches the soldier 25 vehicles in a very short period of time. It should be implemented into every battalion sized units training program.

I have only laudible comments for the combat vehicle identification training. It should be mandatory training for all units administered by S-2 personnel.

I feel that Module 2 should contain at least one (1) threat vehicle. Possible one that has some resemblance to a friendly vehicle so camparisons can be made such as the T72 and AMX30 in Module 4.

Overall comments of personnel tested were highly favorable with many wanting to receive the entire program. Unfortunately, time would not permit this.

Due to the time restrictions mentioned, training was conducted on the basis of one (1) module per tank crew.

(1) There should be a pre-test.
(2) Presentations should include modern vehicle such as BMP, BMD, BRDM, and M60A2 as soon as possible.
(3) I can confirm that student retention is drastically reduced if more than 2 hours are taught each day.
(4) The CVI package must be available in several copies to Bde size units to make max use of limited training "windows".
(5) It is a super package that should be expanded to include new vehicles against various terrain features and lighting conditions.

A lack of a pretest made the class repitious for those who were able to already identify the vehicles.

Need to show a BMP, BMD, SP 122, SP 152, BRDM-2, ASU-57/58. If not all of these at least the BMP, BMD and BRDM-2. And since we talk about he M109 maybe the SP 122 and SP 152. A program like this would also be great for aircraft.

(a) The worksheets should be consolidated into fewer sheets of paper; Sections A, B, and C could be put on one sheet of paper. In teaching 3 or 4 modules to 5 different units, I used well over 1000 sheets of paper.

(b) I used Module 7 at the beginning of the class as a pretest or intro to the other modules, and then after teaching 3 or 4 modules I used it again for score. Using Module 7 in this manner proved to be positive reinforcement to the students. Before the class they could correctly identify no more than 5 vehicles, but after the class they could identify 15 or 20 and make reasonable guesses at 5 more.

(c) Initially I kept the size of the projected image small enought to simulate ranges from 150 to 400 meters with the naked eye. But in later classes I found I could hold the student's interest longer if they could see a larger image. I did demonstrate how longer ranges could be simulated, but the students learned more about the vehicles viewing larger images. In classes repeated for special groups like forward observers who are familiar with most of the vehicles to start with, it may be useful to simulate the longer ranges.

(d) The lesson plans are excellent. After using them myself, I would have no hesitation in letting junior NCO's with less experience as an instructor use them alone as long as they were able to read instructions aloud clearly.

(e) Although I did not try it in my classes, I would think showing slides and pictures in different scale and from sources outside the CVI program would reinforce what the students have learned rather than confuse them. The models in this program do not show all the paraphenalia attached to the turret of an M60 tank or the hull of a Marder for example. Certainly these extraneous slides should not be intermixed with the program's slides, but they could be shown at the end of a module or during rest breaks.

In an effort to stress situation awareness the Wing recommends slides of enemy and friendly formations instead of individual pieces of equipment. Of particular interest was formations of the Meeting Engagement, the Breakthru, and River crossings. These formations should reflect the Air Defense weapon systems organic to that particular unit, i.e., Motorized Rifle Regt., Tank Div., etc. The photographs of these formations should simulate the field of view from an aircraft at low altitudes.

The squadron felt that the identification program should encompass formation, both friendly and enemy. The placement of Air Defense threats in these formations and their importance in determining friend or foe was discussed in detail. The use of aerial view type photography was felt would produce a product more beneficial to the pilots.

The squadron feels that the use of formations would be more beneficial in identifying friend or foe than specific equipment items. The use of desert terrain features with associated camouflage was also suggested. These formations should include threat systems such as the ZSU 23-4, SA-6, SA-8, and SA-9. The squadron also stated that an aerial type view would much better serve their purposes.

The squadron felt that this is the best Combat Vehicle Recognition Program as far as scale and content that they have ever seen. The use of formation slides was suggested. Air Defense weapons were of special interest for use in formations. The squadron felt the ground view photographs of the equipment were beneficial, however aerial views of the equipment would much better serve their identification training.

The class should be given in 2 hour blocks of instruction to small groups over a period of one week with the final test phase being the last class.

I think the number of vehicles should be increased to make the program more directly applicable to SQTs.

Wider selection of combat vehicles and easier access to the CVI itself.

There should be a 7-8 sec delay between slides on final test. It was difficult for trainers to identify and write on score sheet. Some had problems keeping track of sequence. All due to the test sequence. Could be more effective with more accuracy.

Have actual models on hand for close-up inspection.
Have an advanced program which includes hull defilade pictures.
Have some pictures in which the turrets are not in line with the main axis of the vehicle.
Score more points for Friendly-Threat than for the I.D.
Have some slides showing side-by-side comparison for "problem" tanks such as T55-M48 and AMX-30-T72 (especially on front views).

Some models poor representation of real thing, e.g. PT76--poor slide, track on one vehicle warped.

APPENDIX C

ANALYSIS OF VARIANCE SUMMARY TABLES

TABLE C1

ANALYSIS OF VARIANCE FOR RECOGNITION SCORES
OBTAINED DURING MODULE 7 TESTING*

SV	DF	SS	MS	F
Groups	1	593.096	593.096	6.07**
Soldiers within Groups	182	17769.262	97.633	
Vehicles	24	136.421	5.684	13.16***
Groups x Vehicles	24	62.765	2.615	6.05***
Soldiers x Vehicles within Groups	4368	1886.334	.432	

*Sample used was soldiers who were originally trained on modules 1-5 and post-tested on module 7 (N=87) and soldiers receiving no modules 1-5 training (N=97)

** $p<.02$

*** $p<.001$

TABLE C2

ANALYSIS OF VARIANCE FOR IDENTIFICATION SCORES
OBTAINED DURING MODULE 7 TESTING*

SV	DF	SS	MS	F*
Groups	1	7719.777	7719.777	60.33**
Soldiers within Groups	182	23289.418	127.964	
Vehicles	24	173.663	7.236	25.66**
Groups x Vehicles	24	56.852	2.369	8.40**
Soldiers x Vehicles within Groups	4368	1231.005	.282	

*Sample used was soldiers who were originally trained on modules 1-5 and post tested on module 7 (N=87) and soldiers receiving no module 1-5 training (N=97).

** $p<.001$

TABLE C3

ANALYSIS OF VARIANCE FOR RECOGNITION SCORES
OBTAINED DURING MODULE 1-5 TRAINING*

SV	DF	SS	MS	F
Soldiers	86	403.800	4.695	
Modules	4	22.159	5.540	5.97**
Vehicles within Modules	20	25.784	1.289	6.08**
Soldiers x Modules	344	319.281	.928	
Soldiers x Vehicles within Modules	1720	363.816	.212	

*Based on soldiers who were originally trained on modules 1-5 and post tested on module 7.

** p<.001

TABLE C4

ANALYSIS OF VARIANCE FOR IDENTIFICATION SCORES
OBTAINED DURING MODULE 1-5 TRAINING*

SV	DF	SS	MS	F
Soldiers	86	710.813	8.263	
Modules	4	10.667	2.667	2.02 n.s
Vehicles within Modules	20	47.149	2.357	7.41**
Soldiers x Modules	344	454.053	1.320	
Soldiers x Vehicles within Modules	1720	546.851	.318	

** Based on soldiers who were originally trained on modules 1-5 and post tested mon module 7.

** p<.001

TABLE C5

ANALYSIS OF VARIANCE FOR RECOGNITION SCORES DURING TRAINING (Modules 1-5) AND ON MODULE 7 TEST*

SV	DF	SS	MS	F
Soldiers	86	521.298	6.062	
Groups (Mod 1-5 vs 7)	1	238.235	238.235	103.81**
Vehicles	24	31.004	1.292	4.44**
Groups x Vehicles	24	32.397	1.350	5.07**
Soldiers x Groups	86	197.365	2.295	
Soldiers x Vehicles	2064	600.276	.291	
Soldiers x Groups x Vehicles	2064	550.003	.266	

*Comparisons were made on comparable vehicle views between modules 1-5 and module 7. Sample used was soldiers originally trained on modules 1-5 and post-tested on module 7.

** $p<.001$

TABLE C6

ANALYSIS OF VARIANCE FOR IDENTIFICATION SCORES DURING TRAINING (MODULES 1-5) AND ON MODULE 7 TEST*

SV	DF	SS	MS	F
Soldiers	86	666.541	7.750	
Groups (Mod 1-5 vs 7)	1	864.304	864.304	296.52**
Vehicles	24	86.470	3.603	10.86**
Groups x Vehicles	24	89.093	3.712	11.69**
Soldiers x Groups	86	250.676	2.915	
Soldiers x Vehicles	2064	684.850	.332	
Soldiers x Groups x Vehicles	2064	655.427	.318	

*Comparisons were made on comparable vehicle views between modules 1-5 and module 7. Sample used was soldiers originally trained on modules 1-5 and post-tested on module 7.

**$p<.001$

TABLE C7

ANALYSIS OF VARIANCE OF VEHICLE RECOGNITION SCORES
FOR MODULE 6 vs SAME VEHICLE IN MODULES 1 THROUGH 5

	DF	SS	MS	F
Soldiers	88	186.119	2.115	
MOD 1-5 vs MOD 6	1	5.664	5.664	6.86*
Vehicles	4	42.231	10.558	24.01*
MOD 1-5 vs MOD 6 x Vehicles	4	8.083	2.021	6.02*
Soldiers x MOD 1-5 vs MOD 6	88	72.636	.825	
Soldiers x Vehicles	352	154.769	.440	
Soldiers x MOD 1-5 vs MOD 6 x Vehicles	352	118.117	.336	

* p<.01

TABLE C8

ANALYSIS OF VARIANCE OF VEHICLE IDENTIFICATION SCORES
FOR MODULES 6 vs SAME VEHICLE IN MODULES 1 THROUGH 5

	DF	SS	MS	F
Soldiers	88	375.425	4.266	
MOD 1-5 vs MOD 6	1	4.894	4.894	5.64*
Vehicles	4	30.254	7.563	15.57*
MOD 1-5 vs MOD 6 x Vehicles	4	14.398	3.599	9.43*
Soldiers x MOD 1-5 vs MOD 6	88	76.306	.867	
Soldiers x Vehicles	352	170.946	.486	
Soldiers x MOD 1-5 vs MOD 6 x Vehicles	352	134.402	.382	

* p<.01

APPENDIX D

MEANS AND STANDARD DEVIATIONS FOR VEHICLES

Table D1

MEANS AND STANDARD DEVIATIONS FOR RECOGNITION SCORES ON MODULE 7 FOR SOLDIERS NOT TRAINED ON CVI AND SOLDIERS TRAINED ON CVI (2 views of each vehicle)

Vehicles Originally Grouped in Module #	Vehicle	Non-CVI Trained (N = 97) Mean (max.=2)	Non-CVI Trained (N = 97) S.D	CVI Trained (N = 87) Mean (max.=2)	CVI Trained (N = 87) S.D
	BTR 60P	1.320	.744	1.172	.795
	Scorpion	1.052	.834	1.345	.729
1	M113	1.454	.677	1.368	.733
	Leopard	1.289	.661	1.563	.659
	T-62	1.320	.758	1.391	.737
	Centurion	1.423	.705	1.414	.800
	AMX-13	1.237	.761	1.230	.845
2	Geppard	.649	.751	1.092	.897
	M60 A1	1.485	.663	1.598	.637
	M109	1.247	.854	1.333	.844
	BTR 50	1.485	.647	1.345	.775
	Saladin	1.021	.763	1.345	.819
3	ZSU23-4	1.588	.591	1.310	.797
	M551	1.289	.706	1.310	.797
	M48	1.041	.789	1.218	.689
	Marder	.804	.772	1.207	.794
	AMX 30	.680	.758	1.230	.803
4	PT 76	1.175	.722	1.046	.806
	Scimitar	1.082	.799	1.287	.834
	T-72	1.186	.712	1.483	.697
	T54/55	1.278	.732	1.207	.749
	Jagdpanzer	.928	.781	1.414	.800
5	Chiefton	.990	.729	1.184	.691
	ZSU 57-2	1.443	.645	1.379	.781
	Roland	.722	.826	1.310	.797
Overall recognition mean for all vehicle views as a whole (maximum=50)		29.186		32.782	
S.D.			6.88		12.40

Table D2

MEANS AND STANDARD DEVIATIONS FOR IDENTIFICATION SCORES ON MODULE 7 FOR SOLDIERS NOT TRAINED ON CVI AND SOLDIERS TRAINED ON CVI (2 views of each vehicle)

Vehicles Originally Grouped in Module #	Vehicle	Non-CVI Trained (N = 97) Mean (max.=2)	Non-CVI Trained (N = 97) S.D	CVI Trained (N = 87) Mean (max.=2)	CVI Trained (N = 87) S.D
	BTR 60P	.144	.456	.632	.764
	Scorpion	.247	.560	.724	.773
1	M113	.515	.792	1.115	.895
	Leopard	.299	.598	1.126	.712
	T-62	.381	.636	1.023	.876
	Centurion	.175	.479	.598	.814
	AMX-13	.361	.724	.506	.791
2	Geppard	.082	.400	.333	.693
	M60 Al	.814	.846	1.402	.784
	M109	.464	.817	1.103	.940
	BTR 50	.124	.462	.759	.835
	Saladin	.082	.373	.667	.757
3	ZSU23-4	.278	.641	.805	.926
	M551	.588	.813	.667	.757
	M48	.505	.752	.621	.719
	Marder	.144	.456	.621	.796
	AMX30	.113	.405	.920	.838
4	PT 76	.186	.464	.632	.823
	Scimitar	.062	.282	.552	.759
	T-72	.268	.531	1.103	.793
	T54/55	.155	.441	.322	.539
	Jagdpanzer	.134	.471	.966	.933
5	Chiefton	.186	.464	.632	.749
	ZSU57-2	.113	.430	.816	.870
	Roland	.052	.302	.805	.847
Overall recognition mean for all vehicle views as a whole (maximum=50)		6.470		19.448	
S.D.			9.41		13.11

Table D3

MEANS AND STANDARD DEVIATIONS OF VEHICLE RECOGNITION AND IDENTIFICATION PERFORMANCE FOR SOLDIERS TRAINED ON MODULES 1-5 (Three views each vehicle)(N=87)

		Recognition (N = 87)		Identification (N = 87)	
Module #	Vehicle	Mean (max.=3)	S.D	Mean (max.=3)	S.D
	BTR 60P	2.66	.73	2.23	1.20
	Scorpion	2.68	.78	2.49	.96
	M113	2.82	.56	2.68	.80
1	Leopard	2.44	.83	2.17	1.08
	T-62	2.79	.57	2.49	1.03
	Module Total (max.=15)	13.38	2.73	12.07	4.20
	Centurion	2.80	.68	2.72	.66
	AMX-13	2.86	.57	2.22	1.20
	Geppard 2	2.84	.61	2.71	.76
2	M60A1	2.92	.41	2.83	.57
	M109	2.97	.24	2.57	.84
	Module Total	14.39	2.18	13.06	3.13
	BTR 50	2.70	.85	2.63	.85
	Saladin	2.68	.78	2.61	.84
	ZSU23-4	2.51	.90	2.43	1.00
3	M551	2.69	.72	2.51	.91
	M48	2.72	.76	2.61	.87
	Module Total	13.30	3.58	12.78	4.03
	Marder	2.68	.67	2.67	.71
	AMX 30	2.29	.98	2.36	.90
	PT 76	2.69	.69	2.60	.84
4	Scimitar	2.69	.70	2.55	.85
	T-72	2.51	.87	2.33	1.04
	Module Total	12.85	3.12	12.51	3.58
	T54/55	2.59	.72	2.57	.71
	Jagdpanzer	2.75	.65	2.57	.88
5	Chiefton	2.76	.57	2.57	.78
	ZSU 57-2	2.57	.84	2.49	.91
	Roland	2.74	.64	2.70	.79
	Module Total	13.40	2.69	12.92	3.35

Table D4

MEANS AND STANDARD DEVIATIONS OF VEHICLE RECOGNITION PERFORMANCE FOR SOLDIERS DURING TRAINING (Two views for each vehicle on Modules 1-5) AND MODULE 7 TEST

		Training Module Tests (N = 87)		Module 7 Final Test (N = 87)	
Module #	Vehicle	Mean (max.=2)	S.D	Mean (max.=2)	S.D
1	BTR 60P	1.76	.53	1.17	.80
	Scorpion	1.79	.53	1.34	.73
	M113	1.89	.39	1.37	.73
	Leopard	1.52	.68	1.56	.66
	T-62	1.85	.39	1.39	.74
	Module Total	8.80	1.83	6.84	2.52
2	Centurion	1.89	.44	1.41	.80
	AMX-13	1.90	.43	1.23	.84
	Geppard	1.90	.40	1.09	.90
	M60 A1	1.94	.28	1.60	.64
	M109	1.98	.15	1.33	.84
	Module Total	9.60	1.51	6.67	3.11
3	BTR 50	1.78	.60	1.34	.78
	Saladin	1.76	.59	1.34	.82
	ZSU23-4	1.71	.61	1.31	.80
	M551	1.76	.55	1.31	.80
	M48	1.79	.55	1.22	.69
	Module Total	8.80	2.51	6.53	2.76
4	Marder	1.71	.57	1.21	.79
	AMX 30	1.49	.73	1.23	.80
	PT 76	1.78	.52	1.05	.81
	Scimitar	1.80	.48	1.29	.83
	T-72	1.67	.58	1.48	.70
	Module Total	8.46	2.23	6.25	2.80
5	T54/55	1.66	.61	1.21	.75
	Jagdpanzer	1.80	.50	1.41	.80
	Chiefton	1.80	.45	1.18	.69
	ZSU57-2	1.72	.60	1.38	.78
	Roland	1.83	.44	1.31	.80
	Module Total	8.82	1.86	6.49	2.55

TABLE D5

MEANS AND STANDARD DEVIATIONS OF VEHICLE IDENTIFICATION PERFORMANCE FOR SOLDIERS DURING TRAINING (Two views each vehicle on Modules 1-5) AND MODULE 7 TEST

		Training Module Tests (N=87)		Module 7 Final Test (N=87)	
Module #	Vehicle	Mean (max.=2)	Standard Deviation	Mean (max.=2)	Standard Deviation
1	BTR 60P	1.46	.82	.63	.76
	Scorpion	1.69	.67	.72	.77
	M113	1.79	.53	1.11	.89
	Leopard	1.34	.78	1.13	.71
	T-62	1.64	.71	1.02	.88
	Module Total	7.93	2.75	4.62	2.83
2	Centurion	1.80	.50	.60	.81
	AMX-13	1.48	.83	.51	.79
	Geppard	1.80	.52	.33	.69
	M60A1	1.89	.39	1.40	.78
	M109	1.70	.57	1.10	.94
	Module Total	8.68	2.06	3.94	3.07
3	BTR 50	1.72	.62	.76	.83
	Saladin	1.74	.58	.67	.76
	ZSU23-4	1.63	.73	.80	.93
	M551	1.64	.66	.67	.76
	M48	1.74	.58	.62	.72
	Module Total	8.47	2.70	3.52	2.83
4	Marder	1.74	.56	.62	.80
	AMX 30	1.55	.66	.92	.84
	PT 76	1.68	.64	.63	.82
	Scimitar	1.71	.57	.55	.76
	T-72	1.53	.71	1.10	.79
	Module Total	8.21	2.51	3.83	2.94
5	T54/55	1.64	.61	.32	.54
	Jagdpanzer	1.69	.67	.97	.93
	Chiefton	1.64	.61	.63	.75
	ZSU 57-2	1.67	.60	.82	.87
	Roland	1.80	.55	.80	.85
	Module Total	8.45	2.39	3.54	2.99

TABLE D6

MEANS AND STANDARD DEVIATIONS OF VEHICLE RECOGNITION PERFORMANCE FOR SOLDIERS DURING ORIGINAL TRAINING (Modules 1-5) AND FOLLOWING MODULE 6 TRAINING (N=89)

	Training Module Tests		Module 6 Test	
Vehicle	Mean (max.=3)	Standard Deviation	Mean (max.=3)	Standard Deviation
Leopard	2.51	.79	2.63	.70
T-72	2.51	.87	2.52	.81
AMX-30	2.31	.96	1.96	.90
M60 A1	2.92	.41	2.63	.77
T 62	2.81	.56	2.53	.84
All Vehicles	13.06	2.37	12.26	3.01

TABLE D7

MEANS AND STANDARD DEVIATIONS OF VEHICLE IDENTIFICATION PERFORMANCE FOR SOLDIERS DURING ORIGINAL TRAINING (Modules 1-5) AND FOLLOWING MODULE 6 TRAINING (N=89)

	Training Module Tests		Module 7 Test	
Vehicle	Mean (max.=3)	Standard Deviation	Mean (max.=3)	Standard Deviation
Leopard	2.17	1.10	2.46	.77
T-72	2.30	1.06	2.21	.92
AMX 30	2.36	.90	1.88	.95
M60 A1	2.80	.64	2.55	.83
T-62	2.49	1.02	2.28	.99
All Vehicles	12.12	3.59	11.38	3.58

Max.=15

APPENDIX E

DUNCAN MULTIPLE RANGE TEST RESULTS FOR RECOGNITION AND IDENTIFICATION PERFORMANCE ON MODULE 1-5 TRAINING

Instructions for Use of Tables

Results summarized in the table for recognition (pp. E-2 through E-7) provide a measure of the difficulty in learning to recognize the CVI vehicles used during training. Column and row headings of this table indicate the Rank of the vehicle mean, the Module in which the vehicle was trained, the Vehicle name and the Recognition mean. To use this table select two vehicles of interest. Find one of those vehicles on the row and the other on the column. The entry in the intersection of the row and column indicates whether there was a significant difference in the ability to learn to recognize these two vehicles. If the entry in the intersection is blank, look for the first vehicle in the row instead of the column and the second vehicle in the column instead of the row. This matrix is symmetric and entries are made only in the lower half--below the main diagonal. For example, suppose the vehicles of interest were the M551 and BTR 50. The M551 is found on p. E-4 in a row with a rank of 11 and the BTR 50 is found in a column on this page with a rank of 14. Since the intersection of this row and column is blank, find the M551 in a column and the BTR 50 in a row on this page. The entry at this intersection is "NS" which means that there is no significant difference in the ability to learn to recognize these two vehicles.

The same procedure is to be used to read tables on pages E-8 through E-13, which are for identification.

Table E1

Duncan Multiple Range Test Results for Recognition

Rank/Module/Vehicle Mean	1/4/AMX30 2.287	2/1/Leo 2.437	3/3/ZSU234 2.506	4/4/T72 2.506	5/5/ZSU572 2.575	6/5/T54/55 2.586	7/1/BTR60 2.655
1/4/AMX30 2.287							
2/1/Leo 2.437	p<.05						
3/3/ZSU234 2.506	p<.05	NS					
4/4/T72 2.506	p<.05	NS	NS				
5/5/ZSU572 2.575	p<.05	NS	NS	NS			
6/5/T54/55 2.586	p<.05	p<.05	NS	NS	NS		
7/1/BTR60 2.655	p<.05	p<.05	p<.05	p<.05	NS	NS	
8/1/Scorp 2.678	p<.05	p<.05	p<.05	p<.05	NS	NS	NS
9/3/Sala 2.678	p<.05	p<.05	p.<.05	p<.05	NS	NS	NS
10/4/Marder 2.678	p<.05	p<.05	p<.05	p<.05	NS	NS	NS
11/3/M551 2.690	p<.05	p<.05	p<.05	p<.05	NS	NS	NS
12/4/PT76 2.690	p<.05	p<.05	p<.05	p<.05	NS	NS	NS
13/4/Scim 2.690	p<.05	p<.05	p<.05	p<.05	NS	NS	NS
14/3/BTR50 2.701	p<.05	p<.05	p<.05	p<.05	NS	NS	NS
15/3/M48 2.724	p<.05	p<.05	p<.05	p<.05	NS	NS	NS

Rank/Module/Vehicle Mean	1/4/AMX30 2.287	1/1/Leo 2.437	3/3/ZSU234 2.506	4/4/T72 2.506	5/5/ZSU572 2.575	6/5/T5455 2.586	7/1/BTR60 2.655
16/5/Roland 2.736	$p<.05$	$p<.05$	$p<.05$	$p<.05$	NS	NS	NS
17/5/JAGD 2.747	$p<.05$	$p<.05$	$p<.05$	$p<.05$	$p<.05$	NS	NS
18/5/Chief 2.759	$p<.05$	$p<.o5$	$p<.05$	$p<.05$	$p<.05$	$p<.05$	NS
19/1/T62 2.793	$p<.05$	$p<.05$	$p<.05$	$p<.05$	$p<.05$	$p<.05$	NS
20/2/Cen 2.805	$p<.05$	$p<.05$	$p<.05$	$p<.05$	$p<.05$	$p<.05$	NS
21/1/M113 2.816	$p<.05$	$p<.05$	$p<.05$	$p<.05$	$p<.05$	$p<.05$	NS
22/2/Gep 2.839	$p<.05$	$p<.05$	$p<.06$	$p<.05$	$p<.05$	$p<.05$	$p<.05$
23/2/AMX13 2.862	$p<.05$	$p<.05$	$p<.05$	$p<.05$	$p<.05$	$p<.05$	$p<.05$
24/2/M60A1 2.920	$p<.05$	$p<.05$	$p<.05$	$p<.05$	$p<.05$	$p<.05$	$p<.05$
25/2/M109 2.966	$p<.05$	$p<.05$	$p<.05$	$p<.05$	$p<.05$	$p<.05$	$p<.05$

Rank/Module/Vehicle Mean	8/1/Scorp 2.678	9/3/Sala 2.678	10/4/Marder 2.678	11/3/M551 2.690	[illegible]PT76 [illegible].690	13/4/Scim 2.690	14/3/BTR50 2.701
1/4/AMX30 2.287							
2/1/Leo 2.437							
3/3/ZSU234 2.506							
4/4/T72 2.506							
5/5/ZSU572 2.575							
6/5/T5455 2.586							
7/1/BTR60 2.655							
8/1/Scorp 2.678							
9/3/Sala 2.678	NS						
10/4/Marder 2.678	NS	NS					
11/3/M551 2.690	NS	NS	NS				
12/4/PT76 2.690	NS	NS	NS	[illegible]			
13/4/Scim 2.690	NS	NS	NS	[illegible]	[illegible]		
14/3/BTR50 2.701	NS	NS	NS	[illegible]	[illegible]	NS	
15/3/M48 2.724	NS	NS	NS	[illegible]	[illegible]	NS	NS

Rank/Module/Vehicle Mean	8/1/Scorp 2.678	9/3/Sala 2.678	10/4/Marder 2.678	11/3/M551 2.690	12/4[illegible] 2.6[illegible]	[illegible]im [illegible]	14/3/BTR50 2.701
16/5/Roland 2.736	NS	NS	NS	NS	[illegible]	NS	NS
17/5/JAGD 2.747	NS	NS	NS	NS	NS	NS	NS
18/5/Chief 2.759	NS	NS	NS	NS	NS	NS	NS
19/1/T62 2.793	NS	NS	NS	NS	NS	NS	NS
20/2/Cen 2.805	NS	NS	NS	NS	NS	NS	NS
21/1/M113 2.816	NS	NS	NS	NS	NS	NS	NS
22/2/Gep 2.839	NS	NS	NS	NS	NS	NS	NS
23/2/AMX13 2.862	p<.05	p<.05	p<.05	p<.05	p<.05	p<.05	NS
24/2/M60A1 2.920	p<.05	p<.05	p<.05	p<.05	p<.05	p<.05	p<.05
25/2/M109 2.966	p<.05	p<.05	p<.05	p<.05	p<.05	p<.05	p<.05

Rank/Module/Vehicle Mean	15/3/M48 2.724	16/5/Roland 2.736	17/5/JAGD 2.747	18/5/Chief 2.759	19/1/T62 2.793	20/2/Cen 2.805	21/1/M113 2.816
16/5/Roland 2.736	NS						
17/5/JAGD 2.747	NS	NS					
18/3/Chief 2.759	NS	NS	NS				
19/1/T62 2.793	NS	NS	NS	NS			
20/2/Cen 2.805	NS	NS	NS	NS	NS		
21/1/M113 2.816	NS	NS	NS	NS	NS	NS	
22/2/Gep 2.839	NS	NS	NS	NS	NS	NS	NS
23/2/AMX13 2.862	NS	NS	NS	NS	NS	NS	NS
24/2/M60A1 2.920	p<.05	p<.05	p<.05	p<.05	NS	NS	Ns
25/2/M109 2.966	p<.05	p<.05	p<.05	p<.05	p<.05	p<.05	NS

Rank/Module/Vehicle Mean	22/2/Gep 2.839	23/2/AMX13 2.862	24/2/M60A1 2.920
16/5/Roland 2.736			
17/5/JAGD 2.747			
18/5/Chief 2.759			
19/1/T62 2.793			
20/2/Cen 2.805			
21/1/M113 2.816			
22/2/Gep 2.839			
23/2/AMX13 2.862	NS		
24/2/M60A1 2.920	NS	NS	
25/2/M109 2.966	NS	NS	NS

Table E2

Duncan Multiple Range Test Results for Identification

Rank/Module/Vehicle Mean	1/1/Leo 2.172	2/2/AMX13 2.218	3/1/BTR60 2.230	4/4/T72 2.333	5/4/AMX30 2.356	6/3/ZSU234 2.425	7/1/T62 2.494
1/1/Leo 2.172							
2/2/AMX13 2.218	NS						
3/1/BTR60 2.230	NS	NS					
4/4/T72 2.333	NS	NS	NS				
5/4/AMX30 2.356	NS	NS	NS	NS			
6/3/ZSU234 2.425	p<.05	p<.05	p<.05	NS	NS		
7/1/T62 2.494	p<.05	p<.05	p<.05	NS	NS	NS	
8/1/Scorp 2.494	p<.05	p<.05	p<.05	NS	NS	NS	NS
9/5/ZSU57 2.494	p<.05	p<.05	p<.05	NS	NS	NS	NS
10/3/M551 2.506	p<.05	p<.05	p<.05	NS	NS	NS	NS
11/4/Scim 2.552	p<.05	p<.05	p<.05	p<.05	p<.05	NS	NS
12/5/T5455 2.575	p<.05	p<.05	p<.05	p<.05	p<.05	NS	NS
13/5/Jagd 2.575	p<.05	p<.05	p<.05	p<.05	p<.05	NS	NS
14/5/Chief 2.575	p<.05	p<.05	p<.05	p<.05	p<.05	NS	NS
15/2/M109 2.575	p<.05	p<.05	p<.05	p<.05	p<.05	NS	NS

Rank/Module/Vehicle Mean	1/1/Leo 2.172	2/2/AMX13 2.218	3/1/BTR60 2.230	4/4/T72 2.333	5/4/AMX30 2.356	6/3/ZSU234 2.425	7/1/T62 2.494
16/4/PT76 2.598	$p<.05$	$p<.05$	$p<.05$	$p<.05$	$p<.05$	NS	NS
17/3/M48 2.609	$p<.05$	$p<.05$	$p<.05$	$p<.05$	$p<.05$	NS	NS
18/3/Sala 2.609	$p<.05$	$p<.05$	$p<.05$	$p<.05$	$p<.05$	NS	NS
19/3/BTR50 2.632	$p<.05$	$p<.05$	$p<.05$	$p<.05$	$p<.05$	$p<.05$	NS
20/4/Marder 2.667	$p<.05$	$p<.05$	$p<.05$	$p<.05$	$p<.05$	$p<.05$	NS
21/1/M113 2.678	$p<.05$	$p<.05$	$p<.05$	$p<.05$	$p<.05$	$p<.05$	NS
22/5/Roland 2.701	$p<.05$	$p<.05$	$p<.05$	$p<.05$	$p<.05$	$p<.05$	$p<.05$
23/2/Gep 2.713	$p<.05$	$p<.05$	$p<.05$	$p<.05$	$p<.05$	$p<.05$	$p<.05$
24/2/Cen 2.724	$p<.05$	$p<.05$	$p<.05$	$p<.05$	$p<.05$	$p<.05$	$p<.05$
25/2/M60A1 2.827	$p<.05$	$p<.05$	$p<.05$	$p<.05$	$p<.05$	$p<.05$	$p<.05$

Rank/Module/Vehicle Mean	8/1/Scorp 2.494	9/5/ZSU57 2.494	10/3/M551 2.506	11/4/Scim 2.552	12/5/T5455 2.575	13/5/Jagd 2.575	14/5/Chief 2.575
1/1/Leo 2.172							
2/2/AMX13 2.218							
3/1/BTR60 2.230							
4/4/T72 2.333							
5/4/AMX30 2.356							
6/3/ZSU234 2.425							
7/1/T62 2.494							
8/1/Scorp 2.494							
9/5/ZSU57 2.494	NS						
10/3/M551 2.506	NS	NS					
11/4/Scim 2.552	NS	NS	NS				
12/5/T5455 2.575	NS	NS	NS	NS			
13/5/Jagd 2.575	NS	NS	NS	NS	NS		
14/5/Chief 2.575	NS	NS	NS	NS	NS	NS	
15/2/M109 2.575	NS	NS	NS	NS	NS	NS	NS

Rank/Module/Vehicle Mean	8/1/Scorp 2.494	9/5/ZSU57 2.494	10/3/M551 2.506	11/4/Scim 2.552	12/5/T5455 2.575	13/5/Jagd 2.575	14/5/Chief 2.575
16/4/PT76 2.598	NS	NS	NS	NS	NS	NS	NS
17/3/M48 2.609	NS	NS	NS	NS	NS	NS	NS
18/3/Sala 2.609	NS	NS	NS	NS	NS	NS	NS
19/3/BTR50 2.632	NS	NS	NS	NS	NS	NS	NS
20/4/Marder 2.667	NS	NS	NS	NS	NS	NS	NS
21/1/M113 2.678	NS	NS	NS	NS	NS	NS	NS
22/5/Roland 2.701	$p<.05$	$p<.05$	NS	NS	NS	NS	NS
23/2/Gep 2.713	$p<.05$	$p<.05$	$p<.05$	NS	NS	NS	NS
24/2/Cen 2.724	$p<.05$	$p<.05$	$p<.05$	NS	NS	NS	NS
25/2/M60A1 2.827	$p<.05$	$p<.05$	$p<.05$	$p<.05$	$p<.05$	$p<.05$	$p<.05$

Rank/Module/Vehicle Mean	15/2/M109 2.575	16/4/PT76 2.598	17/3/M48 2.609	18/3/Sala 2.609	19/3/BTR50 2.632	20/4/Marder 2.667	21/1/M113 2.678
16/4/PT76 2.598	NS						
17/3/M48 2.609	NS	NS					
18/3/Sala 2.609	NS	NS	NS				
19/3/BTR50 2.632	NS	NS	NS	NS			
20/4/Marder 2.667	NS	NS	NS	NS	NS		
21/1/M113 2.678	NS	NS	NS	NS	NS	NS	
22/5/Roland 2.701	NS	NS	NS	NS	NS	NS	NS
23/2/Gep 2.713	NS	NS	NS	NS	NS	NS	NS
24/2/Cen 2.724	NS	NS	NS	NS	NS	NS	NS
25/2/M60A1 2.827	p<.05	p<.05	p<.05	p<.05	p<.05	NS	NS

Rank/Module/Vehicle Mean	22/5/Roland 2.701	23/2/Gep 2.713	24/2/Cen 2.724
16/4/PT76 2.598			
17/3/M48 2.609			
18/3/Sala 2.609			
19/3/BTR50 2.632			
20/4/Marder 2.667			
21/1/M113 2.678			
22/5/Roland 2.701			
23/2/Gep 2.713	NS		
24/2/Cen 2.724	NS	NS	
25/2/M60A1 2.827	NS	NS	NS

APPENDIX F

VIEWS PRESENTED IN EACH MODULE

Table F1

Views Presented in Each Module

MODULE 1
Section C (Module Test) — Vehicle View

Vehicle Name	Front	Oblique Right	Oblique Left	Side Right	Side Left
Leopard	1	1			1
M113	1		1	1	
Scorpion	1	1			1
BTR-60P	1		1	1	
T-62	1	1			1
MODULE 2					
M60A1	1	1			1
M109	1		1	1	
AMX-13	1	1			1
Centurion	1		1	1	
Gepard	1		1	1	
MODULE 3					
BTR-50	1	1			1
ZSU-23-4	1		1	1	
M551	1		1	1	
M48	1	1			1
Saladin	1	1			1
MODULE 4					
Marder	1	1			1
Scimitar	1		1		
PT-76	1	1			1
AMX-30	1		1	1	
T-72	1		1	1	
MODULE 5					
T-54/55	1		1	1	
Jagdpnzer	1	1			1
Chieftain	1	1			1
ZSU 57-2	1		1	1	
Roland	1	1			1

MODULE 7 (Final Test)

Vehicle Name	Front	Vehicle View Oblique Right	Oblique Left
M48	1	1	
Scorpion	1	1	
Saladin	1		1
M60A1	1		1
T-72	1		1
Leopard	1	1	
BTR-50	1	1	
BTR-60P	1		1
ZSU 57-2	1		1
Jagdpanzer	1	1	
Marder	1	1	
Scimitar	1		1
M109	1	1	
M113	1	1	
ZSU 23-4	1	1	
T54/55	1		1
AMX-13	1		1
PT-76	1		1
M551	1	1	
Chieftain	1	1	
Centurion	1		1
Roland	1	1	
T-62	1		1
AMX-30	1		1
Gepard	1	1	

APPENDIX G

MEANS SCORES FOR EACH VIEW OF THE 25 VEHICLES

Table G1

MEAN SCORES FOR EACH VIEW OF THE 25 VEHICLES

Modules 1-5

Vehicle Code	Name	R I	Front	Oblique Right	Oblique Left	Side Right	Side Left
1	BTR-60	R			.94		
1	BTR-60	I			.79		
2	BTR-60	R				.90	
2	BTR-60	I				.77	
3	BTR-60	R	.82				
3	BTR-60	I	.67				
1	Scorp	R		.93			
1	Scorp	I		.85			
2	Scorp	R	.86				
2	Scorp	I	.84				
3	Scorp	R					.89
3	Scorp	I					.80
1	M113	R			.95		
1	M113	I			.93		
2	M113	R	.93				
2	M113	I	.86				
3	M113	R				.93	
3	M113	I				.89	
1	Leo	R	.66				
1	Leo	I	.55				
2	Leo	R					.92
2	Leo	I					.83
3	Leo	R		.86			
3	Leo	I		.79			
1	T-62	R	.92				
1	T-62	I	.83				
2	T-62	R		.93			
2	T-62	I		.82			
3	T-62	R					.94
3	T-62	I					.85
1	Cen	R			.93		
1	Cen	I			.93		
2	Cen	R	.95				
2	Cen	I	.87				
3	Cen	R				.92	
3	Cen	I				.92	

Table G1 (Cont'd)

MEAN SCORES FOR EACH VIEW OF THE 25 VEHICLES

Modules 1-5

Vehicle Code	Name	R I	Front	Oblique Right	Oblique Left	Side Right	Side Left
1	AMX-13	R					.97
1	AMX-13	I					.74
2	AMX-13	R	.95				
2	AMX-13	I	.76				
3	AMX-13	R		.94			
3	AMX-13	I		.72			
1	Gep	R			.94		
1	Gep	I			.90		
2	Gep	R	.95				
2	Gep	I	.91				
3	Gep	R			.94		
3	Gep	I			.91		
1	M60A1	R		.98			
1	M60A1	I		.97			
2	M60A1	R	.97				
2	M60A1	I	.92				
3	M60A1	R					.98
3	M60A1	I					.94
1	M109	R			.99		
1	M109	I			.87		
2	M109	R				.99	
2	M109	I				.87	
3	M109	R	.99				
3	M109	I	.83				
1	BTR-50	R					.92
1	BTR-50	I					.91
2	BTR-50	R		.91			
2	BTR-50	I		.86			
3	BTR-50	R	.87				
3	BTR-50	I	.86				
1	Sala	R	.90				
1	Sala	I	.83				
2	Sala	R		.86			
2	Sala	I		.91			
3	Sala	R					.92
3	Sala	I					.87

Table G1 (Cont'd)

MEAN SCORES FOR EACH VIEW OF THE 25 VEHICLES

Modules 1-5

Vehicle Code	Name	R I	Front	Oblique Right	Oblique Left	Side Right	Side Left
1	ZSU-23	R				.79	
1	ZSU-23	I				.79	
2	ZSU-23	R			.86		
2	ZSU-23	I			.82		
3	ZSU-23	R	.85				
3	ZSU-23	I	.82				
1	M551	R				.93	
1	M551	I				.86	
2	M551	R			.89		
2	M551	I			.82		
3	M551	R	.87				
3	M551	I	.83				
1	M-48	R					.93
1	M-48	I					.87
2	M-48	R	.89				
2	M-48	I	.82				
3	M-48	R		.91			
3	M-48	I		.92			
1	Mard	R					.97
1	Mard	I					.93
2	Mard	R	.86				
2	Mard	I	.84				
3	Mard	R		.85			
3	Mard	I		.90			
1	AMX-30	R	.76				
1	AMX-30	I	.80				
2	AMX-30	R				.79	
2	AMX-30	I				.80	
3	AMX-30	R			.74		
3	AMX-30	I			.75		
1	PT-76	R					.91
1	PT-76	I					.92
2	PT-76	R	.90				
2	PT-76	I	.80				
3	PT-76	R		.89			
3	PT-76	I		.87			

Table G1 (Cont'd)

MEAN SCORES FOR EACH VIEW OF THE 25 VEHICLES

Modules 1-5

Vehicle Code	Name	R I	Front	Oblique Right	Oblique Left	Side Right	Side Left
1	Scim	R	.92				
1	Scim	I	.86				
2	Scim	R				.89	
2	Scim	I				.84	
3	Scim	R			.89		
3	Scim	I			.85		
1	T-72	R			.90		
1	T-72	I			.86		
2	T-72	R	.77				
2	T-72	I	.67				
3	T-72	R				.84	
3	T-72	I				.80	
1	T-54/55	R				.93	
1	T-54/55	I				.93	
2	T-54/55	R	.79				
2	T-54/55	I	.77				
3	T-54/55	R			.86		
3	T-54.55	I			.87		
1	Jagd	R					.94
1	Jagd	I					.89
2	Jagd	R	.92				
2	Jagd	I	.84				
3	Jagd	R		.89			
3	Jagd	I		.85			
1	Chief	R	.83				
1	Chief	I	.75				
2	Chief	R		.98			
2	Chief	I		.90			
3	Chief	R					.95
3	Chief	I					.93
1	ZSU-57	R	.84				
1	ZSU-57	I	.79				
2	ZSU-57	R			.89		
2	ZSU-57	I			.87		
3	ZSU-57	R				.85	
3	ZSU-57	I				.83	

Table G1 (Cont'd)

MEAN SCORES FOR EACH VIEW OF THE 25 VEHICLES

Modules 1-5

Vehicle Code	Name	R I	Front	Oblique Right	Oblique Left	Side Right	Side Left
1	Roland	R					.91
1	Roland	I					.90
2	Roland	R	.91				
2	Roland	I	.89				
3	Roland	R		.92			
3	Roland	I		.92			

Table G2

MEAN SCORES FOR EACH VIEW OF THE 25 VEHICLES

Module 7

Code	Vehicle Name	R I	Front	Oblique Right	Oblique Left	Side Right	Side Left
1	AMX-13	R			.61		
1	AMX-13	I			.29		
2	AMX-13	R	.62				
2	AMX-13	I	.22				
1	PT-76	R	.47				
1	PT-76	I	.25				
2	PT-76	R			.57		
2	PT-76	I			.38		
1	M551	R	.63				
1	M551	I	.23				
2	M551	R		.68			
2	M551	I		.44			
1	Chief	R		.76			
1	Chief	I		.44			
2	Chief	R	.43				
2	Chief	I	.22				
1	Cen	R	.69				
1	Cen	I	.33				
2	Cen	R			.72		
2	Cen	I			.26		
1	Roland	R		.74			
1	Roland	I		.45			
2	Roland	R	.57				
2	Roland	I	.36				
1	T-62	R			.70		
1	T-67	I			.54		
2	T-67	R	.69				
2	T-62	I	.48				
1	AMX-30	R			.62		
1	AMX-30	I			.51		
2	AMX-30	R	.61				
2	AMX-30	I	.41				
1	Gep	R	.53				
1	Gep	I	.16				
2	Gep	R		.56			
2	Gep	I		.17			

Table G2 (Cont'd)

MEAN SCORES FOR EACH VIEW OF THE 25 VEHICLES

Module 7

Vehicle Code	Name	R I	Front	Oblique Right	Oblique Left	Side Right	Side Left
1	ZSU-57	R			.69		
1	ZSU-57	I			.46		
2	ZSU-57	R	.69				
2	ZSU-57	I	.36				
1	Jagd	R	.66				
1	Jagd	I	.47				
2	Jagd	R		.76			
2	Jagd	I		.49			
1	Mard	R	.59				
1	Mard	I	.29				
2	Mard	R		.62			
2	Mard	I		.33			
1	Scim	R	.70				
1	Scim	I	.24				
2	Scim	R			.59		
2	Scim	I			.31		
1	M109	R		.70			
1	M109	I		.55			
2	M109	R	.63				
2	M109	I	.55				
1	M113	R	.74				
1	M113	I	.53				
2	M113	R		.63			
2	M113	I		.59			
1	ZSU-23	R		.69			
1	ZSU-23	I		.40			
2	ZSU-23	R	.62				
2	ZSU-23	I	.40				
1	T-54/55	R			.72		
1	T-54/55	I			.21		
2	T-54/55	R	.48				
2	T-54/55	I	.11				

Table G2 (Cont'd)

MEAN SCORES FOR EACH VIEW OF THE 25 VEHICLES

Module 7

Code	Vehicle Name	R I	Front	Oblique Right	Oblique Left	Side Right	Side Left
1	M-48	R		.53			
1	M-48	I		.40			
2	M-48	R	.69				
2	M-48	I	.22				
1	Scorp	R		.78			
1	Scorp	I		.46			
2	Scorp	R	.56				
2	Scorp	I	.26				
1	Sala	R	.67				
1	Sala	I	.22				
2	Sala	R			.68		
2	Sala	I			.45		
1	M60A1	R			.83		
1	M60A1	I			.77		
2	M60A1	R	.77				
2	M60A1	I	.63				
1	T-72	R	.66				
1	T-72	I	.48				
2	T-72	R			.83		
2	T-72	I			.62		
1	Leo	R		.86			
1	Leo	I		.75			
2	Leo	R	.70				
2	Leo	I	.38				
1	BTR-50	R	.70				
1	BTR-50	I	.43				
2	BTR-50	R		.64			
2	BTR-50	I		.33			
1	BTR-60	R	.55				
1	BTR-60	I	.24				
2	BTR-60	R			.62		
2	BTR-60	I			.39		

Table G3

MEAN SCORES FOR EACH VIEW OF THE 25 VEHICLES

Module 6

Vehicle Code	Name	R I	Front	Oblique Right	Oblique Left	Side Right	Side Left
1	Leo	R	.75				
1	Leo	I	.67				
2	Leo	R		.94			
2	Leo	I		.90			
3	Leo	R					.93
3	Leo	I					.89
1	T-72	R			.89		
1	T-72	I			.81		
2	T-72	R	.77				
2	T-72	I	.60				
3	T-72	R				.85	
3	T-72	I				.81	
1	AMX-30	R	.68				
1	AMX-30	I	.67				
2	AMX-30	R				.54	
2	AMX-30	I				.54	
3	AMX-30	R			.71		
3	AMX-30	I			.68		
1	M60A1	R		.89			
1	M60A1	I		.87			
2	M60A1	R	.86				
2	M60A1	I	.83				
3	M60A1	R					.86
3	M60A1	I					.86
1	T-62	R				.82	
1	T-62	I				.79	
2	T-62	R			.88		
2	T-62	I			.81		
3	T-62	R	.80				
3	T-62	I	.69				

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